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TINTED WINDSHIELD INVOLVEMENT AMONG CPIR ACCIDENTS

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The University of Michigan
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16. Abstract

The 9222 vehicles in the CPIR3 data set were examined for evidence that would indicate whether tinted windshields cause or prevent accidents. Windshield-tint condition was known for 4185 vehicles, and these were almost evenly split between clear and tinted windshields.

The proportions of tinted windshields among these accident vehicles were smaller than those for U.S.-produced vehicles of comparable model years. Weighted least squares regressions showed that the proportion of drivers having tinted windshields increases as age increases, but that there are no statistically significant differences between daytime and nighttime conditions. It was concluded from the regression analyses that the data do not support the hypothesis that older drivers are negatively influenced at night with tinted windshields.

It was also found that tinted windshields are associated with a variety of driver and vehicular variables believed to influence accident risk. Because of these uncontrolled, confounding variables, and because of methodological limitations associated directly with the CPIR file, it is not possible to isolate the influence of windshield tinting in accident causation or prevention. A controlled study is needed to make such a determination.

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1. INTRODUCTION

The purpose of this technical memorandum is to update parts of the earlier work of Marsh and Arvai concerning the relationship between tinted (heat-absorbent) windshields and accident involvement.[1] They analyzed the involvement of vehicles having tinted and clear windshields from the 3502 vehicles contained in the computer file for accidents reported on the CPIR report form. Forty-two percent of the vehicles could be identified as having either clear or tinted windshields, and of these 1465 vehicles, forty-four percent (639) were equipped with tinted windshields. The authors observed a slight trend for tinted-windshield involvement to increase with age more rapidly for nighttime accidents than for daytime accidents. Their central conclusion, however, was that it was not possible to isolate tinted windshields as either a causative or a non-causative factor in the production of accidents.

The work reported here includes several least-squares regression models applied to three variables of the current version of the same CPIR file. The file now contains 9222 vehicles, of which 8389 (91%) are known to be passenger cars of various body styles. As in the earlier work, relationships between tinted windshields and a number of other variables are also of interest. In the present study these were investigated using bivariate contingency tables and tests of independence on those tables.

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[1] J. Marsh and E. Arvai, Tinted Windshield Involvement, Highway Safety Research Institute, The University of Michigan, Ann Arbor, Michigan, June 1973.

2. DATA SET

The starting point of the present study is the CPIR3 file, containing 9222 vehicles as of Update 'A'. This file was first filtered to include only those 9173 vehicles coded as having a driver in the normal driving position. (This condition is indicated by Code Value 44 of Variable 580, SEAT LOCATION, POSITION.)

Vehicles having the necessary information about windshield color were obtained by re-coding the alpha variable identifying windshields (Variable 343, WINDSHIELD CODE). A two-level numeric variable describing the windshield as either CLEAR (Level 1) or TINT (Level 2) was assigned. The alpha field was empty for 1.2% of the vehicles. Of the 130 alpha codes in the file, 40 identified clear windshields, 54 identified tinted windshields, and 36 were applied to windshields for which the clear-tint classification is unknown. Thus 4185 vehicles could be identified with respect to windshield color, with 2118 (50.6%) having clear windshields and 2067 (49.4%) having tinted windshields. The distribution of the data set by the original alpha code and the re-coded variable is shown in Table A-1 of Appendix A.

All vehicles with an unambiguous code value on the windshield-code variable were retained for subsequent analysis. This was done to maximize the number of cases in order to better find differences between clear and tinted windshield involvement if such existed. Ninety-two percent of these vehicles are passenger cars.

3. ANALYSES

The two primary analytical tools used in this study were contingency table analysis and least-squares regression. Both were carried out in MIDAS, the Michigan Interactive Data Analysis System resident on MTS (Michigan Terminal System). The TWOWAY command generated the bivariate tables contained in Appendix A, and the REGRESSION command was used in the regression analyses after the data had been weighted appropriately.

Contingency Table Analysis

Several contingency tables were formed to determine whether, on a gross basis, tinted windshields were associated with other variables contained in the CPIR file. The central result of these explorations is to confirm the earlier finding that tinted windshields are, in fact, associated with many other vehicle and driver variables, a fact which complicates the inferential process considerably.

Representative of these tables is the twoway cross-tabulation of Precipitation Type (Variable 29) vs. Windshield Color (Variable 2) shown in Table A-5. Cases with missing data on either variable are shown under the applicable MISS classification, but these cases are excluded in all calculations. In this table, as in all of the others in Appendix A, the row and column percentages are included in the twoway output. Also included is a tabulation of the expected frequency under the assumption that the two variables are independent. Thus the row labeled EXPECT contains the number of cases that would be "expected" if the CLEAR and TINT frequencies were distributed in the same proportion as the marginal distribution. The MAXIMUM LIKELIHOOD and CHI-SQUARE TESTS OF INDEPENDENCE statistics are given to test whether the independence assumption holds or not. Both statistics indicate a non-significant association between windshield color and precipitation type.

Table A-3 indicates a significant, but not particularly strong, association between driver age and tinted windshields. All of the four three-year age groups under (28) contain less than 50% tinted windshields, while (28) and higher contain more than 50%. The windshield coloration-driver age relationship is explored more fully with the regression analyses given later.

Table A-4 shows, except for the very early years, a significantly increasing percentage of tinted windshields among the more recently investigated crashes. This is undoubtedly due to the higher proportion of late model cars, themselves with higher percentages of tinted windshields, among those cars investigated in the latter years.

The data of Tables A-5 and A-6 show a non-significant association between tinted windshields and the precipitation condition prevailing at the time of the accident. Table A-7, on the other hand, shows that tinted windshields are significantly under-represented, in this accident population, with respect to their "expected" numbers on roads judged to have been slippery. The data do not provide any suggestions as to why this should be the case.

No significant association exists between tinted windshields and the amount of light prevailing at the time of the accident. This is seen in Table A-8, where the 4-level (day, night, dusk, and dawn) time-of-day variable is tabulated. As in Table A-9 (Visibility Limitation), however, a non-significant trend exists for tinted windshields to be under-represented among the darker conditions on both variables.

Tables A-10, A-11, A-12, and A-14 all demonstrate that the accident data generally associate in the expected manner with the other variables found in the tables. More expensive cars have a higher proportion of tinted windshields, as do late-model cars compared with earlier years. Air-conditioned cars, in this accident population, have 67.7% tinted windshields compared to 18.7% among non-air-conditioned cars.

Variables 338 and 339 in the CPIR file record whether the accident vehicle sustained windshield damage during the accident sequence. It is seen, from Tables A-14 and A-15, that tinted windshields are somewhat, although not significantly so, over-represented among cracked and broken windshields.

Tables A-17 and A-18 also show that, at least among these accident data, drivers of cars with tinted windshields differ from drivers of cars with clear windshields. With respect to occupation, it is seen that 60.5% of the white-collar, accident-involved population had tinted windshields, whereas 39.3% of the blue-collar population was so equipped. Persons in service occupations, housewifes, students, military personnel, and retired persons all had greater than 50% tinted windshields, but farm workers and the unemployed joined the blue-collar workers in the under-50% category.

Table A-18 cross tabulates the CLEAR and TINT windshields with the accident investigator's assessment of responsibility for the accident. Drivers of cars judged to be the most responsible for the accident have somewhat less than half tinted windshields, whereas the second-most responsible drivers have somewhat over half tinted windshields.

Comparison of Accident and Production Data

This section compares the tinted-windshield percentages among these accident vehicles with the tinted-windshield percentage among U.S.-produced cars of recent years. The data are presented in Table 3. The accident data are from Table A-12, and the production data are from Ward's Automotive Reports.

Clearly vehicles with tinted windshields appear much less frequently—and highly significantly so, from a statistical perspective—than the production data suggest should be the case. The differences between the two sets of figures range from over 30% to a minimum of 13%. Rather than to support the claim that tinted windshields in fact prevent accidents, the percentage differences of this size merely highlight the methodological difficulties inherent in this study: good measures of the exposed, at-risk driving population do not exist. The implications of this for future studies are discussed later.

The data simply do not exist that would enable us to postulate and defend, in a scientific sense, alternative explanations for the discrepancies noted. Based on the prior data, however, it seems reasonable to account for the large under-representation of tinted windshields in this accident population compared to U.S. production figures on the basis of the kinds of people who buy and drive cars with tinted windshields, particularly in the earlier years. Perhaps drivers of cars with tinted windshields drive less, on the average, than do drivers of cars with clear windshields.

Table 1

Comparison of Vehicles with Tinted Windshields

Model Year	Percentage of U.S. Production with Tinted Windshields*	CPIR3 File**	
		Percentage with Tinted Windshields	Number of Vehicles
1971	69.6	37.4	788
1972	75.1	48.0	744
1973	78.9	47.0	614
1974	75.0	49.8	502
1975	80.5	65.4	246
1976	79.1	65.7	99
1977	86.8	72.7	11

* SOURCE: Ward's Automotive Reports (Reproduced in MVMA Motor Vehicle FACTS & FIGURES, 1975 and 1978.

** Vehicles with missing data on the "Windshield Code" variable have been excluded.

Perhaps they are inherently more careful drivers, or they drive in generally more sheltered and less hostile environments.

The unfortunate part of the lack of an adequate control group is that there is no way to test the obvious hypothesis that tinted windshields in fact prevent accidents. One would not expect to find differences as large as those observed above just because of tinted windshields, but they may account for some part of the under-representation. Further investigation of this possibility will have to await subsequent, more highly controlled studies than are possible with the data on hand.

Regression Analyses

The preceding section has revealed some interesting, but inconclusive, relationships between tinted windshields and other vehicle and driver variables documented in the CPIR file. This section focuses on the relationship between tinted windshields, age, and the day-night light condition under which the accident occurred.

Gittelsohn studied the relationship between these variables by obtaining weighted least squares regression lines between driver ages and percentage of accidents with tinted windshields for both day and night conditions.[1] He found that the slopes of the two regression lines were similar, and concluded that "... the data demonstrate that the risk of accidents for older persons driving cars with heat-absorbent windshields at night is no greater than during the day." The implicit assumption was that older drivers would be differentially more influenced at night when driving with tinted windshields than during the day if, in fact, tinted windshields had deleterious effects on vision with a concomitant increase in risk. Failure to find support for that hypothesis was an important part of Gittelsohn's claim that tinted windshields did not increase accident risk among the drivers he studied.

The same approach is taken here, for it is one of the few ways to subset the accident data in a manner that is meaningful in terms of the phenomenon under consideration. The procedure can be thought of as using the daytime accident data as a surrogate for a suitable control population and studying the performance of the nighttime drivers relative to the controls. To be noted is that the same technique could be used if one were exploring the hypothesis that tinted windshields prevented daytime accidents without increasing nighttime accidents. It is further the case that the results could very well appear the same; an elevation of the nighttime risk relative to a stable daytime risk under the first hypothesis might be indistinguishable from a depressed daytime risk relative to a stable nighttime risk under the second hypothesis.

The dependent variable in each of the several regression models was the

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[1] A.M. Gittelsohn, "Tinted Windshields Don't Increase Accident Risk," Automotive Engineering, Volume 81, Number 5, May 1973.

percentage of accident-involved vehicles having tinted windshields. The independent variables were age of the driver and a dichotomous, day-night light variable.

Three different age groups were used in the various regression runs. The single-year age groups (Variable 584) and the 5-,10-year bracketed age groups (Variable 583) were tried in various regressions and were subsequently discarded. The single-year ages resulted in the data being too thin in some of the cells and resulted in loss of data when used in the weighted regressions. The 5-,10-year groups pool the data unevenly and their use is not theoretically satisfying.

Accordingly, the age data for the drivers were re-coded into 3-year age groups, and each group was identified by its mean age. Thus, for example, age group 40 contains drivers with ages of 39, 40, and 41. Two exceptions to this procedure pertain. Age group 68 contains drivers aged 66-71 and age group 75 contains drivers aged 72-83. Pooling of the age data in this manner was needed to accommodate the preferred weighted least squares regressions. This procedure was judged preferable to either discarding the data for a few of the older drivers or to arbitrarily estimating the variance for the same groups. The entire age recode is shown in Table A-2.

The dichotomous LIGHT variable was obtained by a simple re-code of the 4-level TIME OF DAY (Variable 36) into two levels. The drivers of "Unknown," "Dusk," and "Dawn" --about 7% of the total--were excluded from the analyses.

All analytical worked was conducted in MIDAS, the interactive data analysis system developed and supported by the University's Statistical Research Laboratory. The REGRESSION command uses only those cases for which all variables are complete, that is there are no missing data on any of the variables included in the analysis. In order to standardize the data set for the various regressions and other analyses, those cases with missing data on any of the age and light variables were also excluded. This resulted in a data set of 3929 drivers with no missing data on their age, the time of day of their accident, or the color (clear vs. tinted) of their vehicle's windshield. The distributions of drivers by these three variables are shown in Appendix A. Of the 3929 drivers, 50.3% had clear windshields and 49.7% had tinted windshields. Of these same drivers, 57.5% (2258) had the accident during the day and 42.5% (1671) at night.

Each of the regressions reported in detail here used weighted least squares. The weight factor for each of the cells is the inverse of the square root of the estimated variance for that cell. For a proportion such as that used here--simply the ratio of the number of tinted windshields to the sum of the tinted and clear windshields--the variance is estimated by N/pq; N is the number of observations, p is the proportion tinted, and q=1-p is the proportion not tinted (clear). A consequence of this weighting procedure is that the age groups with many drivers and with p and q percentages relatively closer to zero and one are weighted more heavily than those age groups not so characterized. Thus older drivers--in age groups 64 and 68, for example--are weighted less heavily than their younger counterparts in age groups 19 and 22.

Summary results of the regression analyses are presented in Tables 2 and 3. Table 2 applies to the four linear regressions, with weighted tint proportion the dependent variable and weighted 3-year age group the independent variable in all cases. In Regression 1, the light variable (coded '1' for DAY and '2' for NIGHT) is omitted, whereas it is included in Regression 2. It can be seen, however, that inclusion of the light variable did not improve the fit appreciably and that the light variable coefficient is not significantly different from zero. This indicates that the age-tint proportion relationship does not differ from day to night. Further, the two age coefficients for these two regressions do not differ from each other significantly.

Regressions 3 and 4 are similar, but in this case Regression 3 applies to the daytime accidents and Regression 4 applies to the nighttime accidents. The light variable, of course, is not included in either of these. Both coefficients of the weighted age variable are significantly different from zero and significantly different from each other. It will be noted, however, that the R-Square term for Regression 3 (0.474) indicates that a good fit to the daytime data has not been achieved.

Accordingly, four additional weighted least squares regression analyses were conducted. This second set of four--summarized in Table 3--parallels the first set of four except for the inclusion of a quadratic term for age. Regressions 5 and 6 both fit the total data set well. As with the linear

Table 2

Summary of Linear Regression Analyses

	Regress. 1	Regress. 2	Regress. 3	Regress. 4
Light	Both	Both	Day	Night
Error Sum Squares (D.F.)	102.51 (36)	101.64 (35)	43.97 (17)	47.31 (17)
R-Square (S.E.)	.64609 (1.6874)	.64382 (1.7041)	.47413 (1.6084)	.71661 (1.6683)
Constant (S.E.) Signif.	.34659 (.32411 -1) .0000	.32304 (.54027 -1) .0000	.38137 (.40646 -1) .0000	.27954 (.50875 -1) .0000
Age Coeff. (S.E.) Signif.	.45026 -2 (.87343 -3) .0000	.45698 -2 (.89055 -3) .0000	.33526 -2 (.10377 -2) .0049	.68912 -2 (.14865 -2) .0000
Light Coeff. (S.E.) Signif.	Absent Absent Absent	(.14843 -1) (.27091 -1) .5873	Absent Absent Absent	Absent Absent Absent

regressions, the light coefficient, in Regression 6, is not significantly different from zero nor are the linear coefficients of age significantly different from each other. Moreover, the coefficients of the quadratic age terms do not differ from each other significantly. These results again are consistent with the hypothesis that the age-windshield tint phenomenon is essentially the same during the day as during the night.

Regressions 7 and 8 in Table 3 are analogous to regressions 3 and 4 of Table 2. Regression 7 includes the daytime data and Regression 8 includes the nighttime data. It will first be noted that both quadratic regressions accomplish an appreciably better fit to the data than do their linear counterparts, particularly for the daytime data where the R-Square has increased from 0.474 to 0.611. Pair-wise comparison of the coefficients of

Table 3

Summary of Quadratic Regression Analyses

	Regress. 5	Regress. 6	Regress. 7	Regress. 8
Light	Both	Both	Day	Night
Error Sum Squares (D.F.)	79.99 (35)	79.48 (34)	32.04 (16)	41.33 (16)
R-Square (S.E.)	.72830 (1.5118)	.72625 (1.5289)	.61107 (1.4151)	.75558 (1.6071)
Constant (S.E.) Signif.	.12680 (.75803 -1) .1033	.11025 (.84417 -1) .0000	.17644 (.91231 -1) .0710	.09183 (.91825 -1) .4987
Age Coeff. (S.E.) Signif.	.17438 -1 (.41945 -2) .0002	.17400 -1 (.42429 -2) .0002	.15213 -1 (.49427 -2) .0072	.18293 -1 (.76216 -2) .0289
Coeff. of Age Squared (S.E.) Signif.	-.15892 -3 (.50628 -4) .0034	-.15781 -3 (.51256 -4) .0041	-.14262 -3 (.58410 -4) .0266	-.14666 -3 (.96296 -4) .1473
Light Coeff. (S.E.) Signif.	Absent Absent Absent	(.11392 -1) (.24332 -1) .6426	Absent Absent Absent	Absent Absent Absent

the linear and quadratic terms now shows, contrary to the finding with the linear regressions of Table 2, non-significant differences between the day and night terms.

Another way of looking at the additional explanatory power of making the day-night split is by comparing the Error Sum of Squares of Regression 5—79.99 with 35 degrees of freedom—with the sum of the Error Sum of Squares from Regressions 7 and 8 together. The latter figure is 73.37 (32.04 + 41.33) with 32 degrees of freedom. The difference between these two--6.62--is itself distributed as Chi-square with three degrees of freedom. This is not a statistically significant difference, again indicating that the further split of the data set into the day-night subsets does not provide additional explanatory power for the phenomenon.

The fitted regression models for the daytime and nighttime light conditions, together with the actual data points, are shown in Figures 1 and 2. Figure 1 shows the original data points--the proportions of tinted windshields by 3-year age group--for the daytime accidents, together with the fitted linear and quadratic models. Figure 2 repeats these plots for the nighttime accidents. The apparent non-linearity in the linear fit--and also the perturbation in the quadratic fit--at age groups 68 and 75 are to be expected. It will be recalled that it was necessary to pool the drivers for these two age groups for analytic purposes, and the selected age groups are not linear with respect to the younger 3-year groupings. This in no way alters the analytical accuracy of the results, but the visual display is slightly distorted.

In sum, weighted least squares regression models--both linear and quadratic--were fit to the proportion of drivers having tinted windshields by 3-year age groups for both day and night accidents. The quadratic models provided acceptably good fits to the actual accident data. The models show that the proportion of drivers having tinted windshields increases as age increases for both the daytime and nighttime accidents. Several different ways of looking at these models shows that there are no statistically significant differences between the daytime and nighttime conditions. It is concluded, therefore, that the data do not support a hypothesis that argues that older drivers are differentially and negatively influenced when driving at night with tinted windshields.

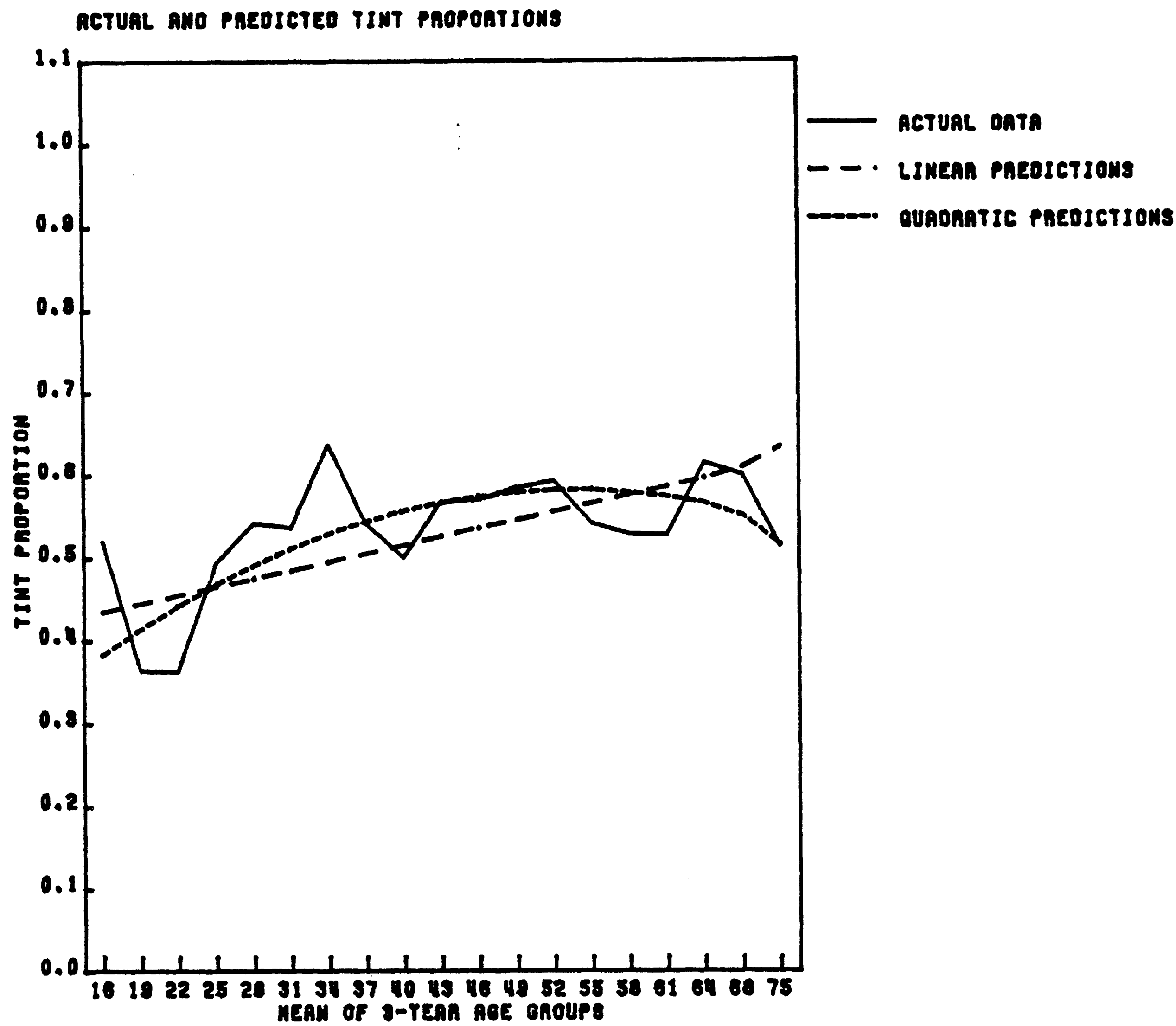

Figure 1

Actual and Fitted Tint Proportions: Day

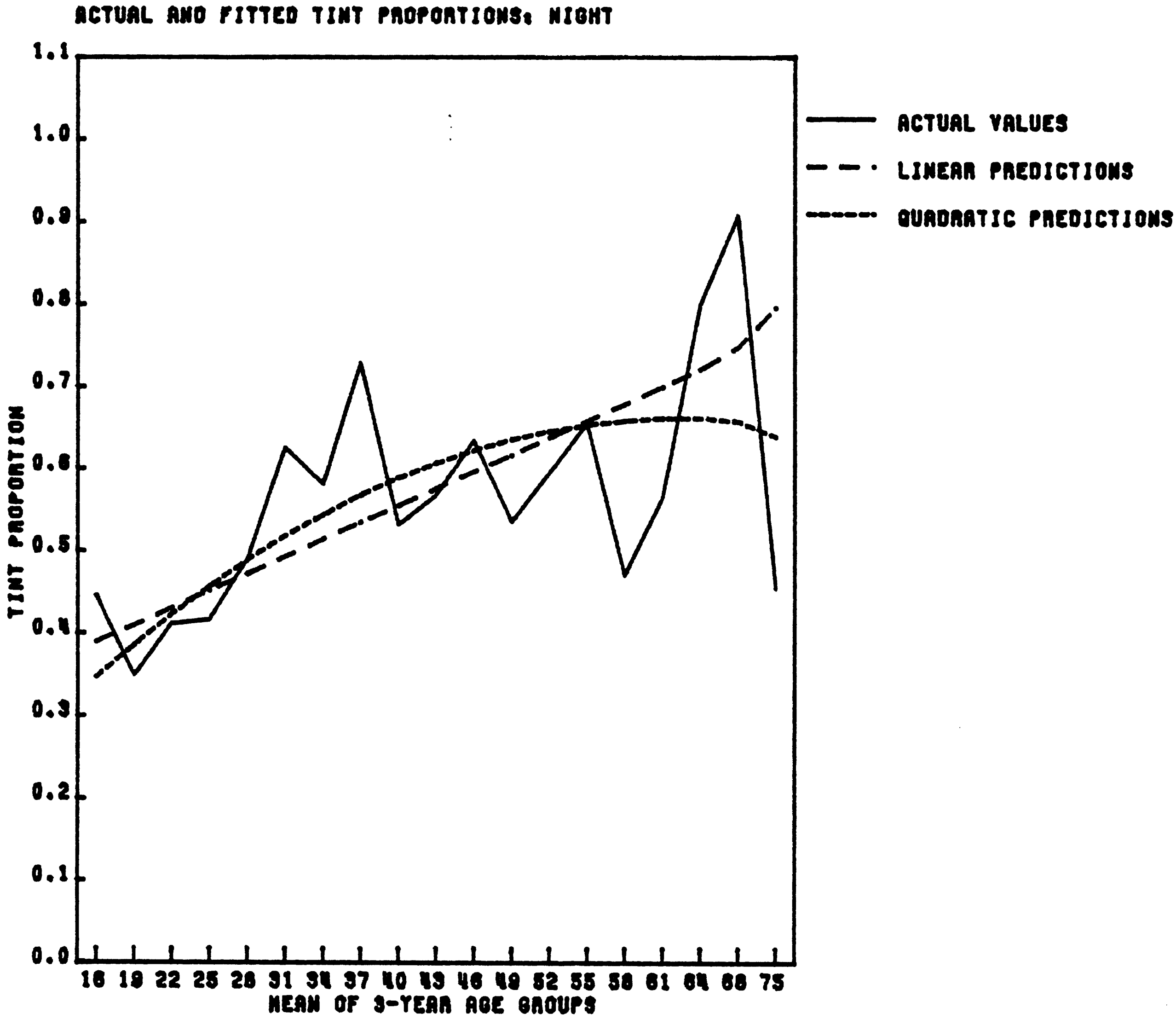

Figure 2

Actual and Fitted Tint Proportions vs. Age: Night

4. DISCUSSION

The preceding results suggest that, among these CPIR data, there is little evidence to support either the hypothesis that tinted windshields cause accidents or the hypothesis that they prevent them. It would be desirable, of course, if the conclusions could be far more definitive and less qualified.

The application of statistical techniques to these sorts of technical issues is appropriate, but a minimum of three conditions must be met so that sound inferences can be drawn. First, the accident data must be sampled correctly so that inferences are not limited to just the population under study. Second, the missing-data rate on the variables of interest within the accident sample must be negligibly small. Third, an adequate description of the at-risk population from which the accident sample is taken must be available so that the necessary comparisons can be made between accident and control samples.

None of these conditions is met in the present case. The CPIR data were obtained from a wide variety of locations and times by many different investigators. The accidents selected for investigation were frequently interesting but far from typical, such as extensive property-damage accidents accompanied by little personal injury, or much personal injury with little property damage. The net result is that it is most hazardous to generalize findings from this data set beyond the limits of the data set itself, particularly with respect to subtle influences such as that under consideration here.

Given the lack of representativeness of the accident data, the missing-data issue on the variables under study is of little practical consequence. For the sake of completeness, however, it can be seen, from Table A-12, that the missing-data frequencies exceed those for the combined CLEAR and TINT categories for the 1971 model year and earlier. As late as the 1976 model year, the missing-data cases comprise some 27%--37 of the 136--vehicles. Whether a bias exists on the windshield color variable for the missing-data vehicles is unknown, of course. But it is reasonable to speculate that windshield information is likely to be missing in the more serious crashes where post-accident investigations are less productive. From other studies it is known that accident severity is associated with such pre-crash factors as speeding, alcohol consumption, and the like. It is not unlikely, therefore, that a bias created by incomplete reporting could exist, and this effect could be larger than either the positive or negative effects caused by tinted windshields.

For these reasons, and the lack of a suitable control group as noted earlier, inferences from this study must be guarded. The results of other studies, whether they claim to establish that tinted windshields cause accidents or prevent them, should also be questioned in light of the soundness of the underlying research methodologies.

5. SUMMARY AND CONCLUSIONS

The CPIR3 data set was examined for evidence that would indicate how tinted windshields are related to accident occurrence. It was found that tinted windshields are associated with a variety of other vehicular and driver variables, some of which are also believed to influence the risk of a crash. Because of these uncontrolled confounding variables, and because of methodological limitations directly associated with the CPIR file, it is not possible to isolate the influence of tinting in accident causation or occurrence. Failure to find an effect one way or the other, although far from conclusive, certainly suggests that whatever effects exist are small.

A well designed and well executed study, with great attention to methodological rigor, is needed if the effects of tinted windshields in causing or preventing accidents are to be determined with confidence. Such a study might be undertaken as a special study within the framework of the National Accident Sampling System.

Appendix-A

BIVARIATE TABULATIONS

TWOWAY CROSS-TABULATION TABLE A-1

2. CCLOR		343.WINDSHLD MISS	AA	AB	AC	AD	AE	AF	AG	AH	AJ	AK	AL	AM	AN	AP	AQ
N=	4185																
TOTAL= ROW%	9173	0	20 .5	74 1.8	72 1.7	6 .1	11 .3	61 1.5	0	27 .6	23 .5	0	15 .4	46 1.1	3 .1	31 .7	23 .5
MISS ROW%	4870	118	0	0	0	0	0	0	1	0	0	3	0	0	0	0	0
CLEAR ROW%	2118	0	20 .9	74 3.5	72 3.4	6 .3	11 .5	61 2.9	0	27 1.3	23 1.1	0	0	0	0	0	0
TINT ROW%	2067	0	0	0	0	0	0	0	0	0	0	0	15 .7	46 2.2	3 .1	31 1.5	23 1.1

	AR	AS	AT	AU	AV	AW	AX	AY	BA	BB	BC	BE	BF	BH	BJ	BL	BM
ROW%	0	11 .3	150 3.6	140 3.3	4 .1	1 .0	5 .1	1 .0	2 .0	5 .1	8 .2	1 .0	4 .1	16 .4	5 .1	1 .0	7 .2
MISS ROW%	6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
CLEAR ROW%	0	0	0	0	0	0	0	0	0	5 .2	8 .4	1 .0	4 .2	0	0	0	0
TINT ROW%	0	11 .5	150 7.3	140 6.8	4 .2	1 .0	5 .2	1 .0	2 .1	0	0	0	0	16 .8	5 .2	1 .0	7 .3

	BO	BP	BQ	BR	BS	CA	CB	CD	CE	CF	CK	CL	CP	CR	DA	DB	DE
ROW%	0	2 .0	2 .0	2 .0	1 .0	37 .9	5 .1	0	12 .3	2 .0	111 2.7	116 2.8	2 .0	12 .3	14 .3	69 1.6	5 .1
MISS ROW%	1	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0
CLEAR ROW%	0	0	0	0	0	37 1.7	0	0	12 .6	0	111 5.2	0	2 .1	0	14 .7	0	5 .2
TINT ROW%	0	2 .1	2 .1	2 .1	1 .0	0	5 .2	0	0	2 .1	0	116 5.6	0	12 .6	0	69 3.3	0

	DF	DK	DL	DM	DN	DP	DR	DS	EA	EB	EK	EL	FA	FB	GA	GB	GC
ROW%	2 .0	270 6.5	517 12.4	1 .0	5 .1	1 .0	10 .2	1 .0	10 .2	3 .1	68 1.6	77 1.8	3 .1	7 .2	8 .2	1 .0	231 5.5
MISS ROW%	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

CLEAR ROW%	0	270 12.7	0	0	5 .2	1 .0	0	0	10 .5	0	68 3.2	0	3 .1	0	8 .4	0	0
TINT ROW%	2 .1	0	517 25.0	1 .0	0	0	10 .5	1 .0	0	3 .1	0	77 3.7	0	7 .3	0	1 .0	231 11.2

	GE	GF	GG	GL	HA	HB	HN	JA	JB	KA	KB	KD	KG	KH	KJ	KN	KP
ROW%	238 5.7	171 4.1	12 .3	0	541 12.9	20 .5	0	1 .0	11 .3	69 1.6	2 .0	1 .0	21 .5	2 .0	3 .1	2 .0	2 .0
MISS ROW%	0	0	0	4	0	0	1	0	0	0	0	0	0	0	0	0	0
CLEAR ROW%	238 11.2	0	0	0	541 25.5	0	0	1 .0	0	69 3.3	0	0	21 1.0	0	0	2 .1	0
TINT ROW%	0	171 8.3	12 .6	0	0	20 1.0	0	0	11 .5	0	2 .1	1 .0	0	2 .1	3 .1	0	2 .1

	KR	LA	LB	MA	MB	NC	ND	NE	NF	NG	NN	NW	NY	OC	OK	PA	QA
ROW%	1 .0	304 7.3	91 2.2	148 3.5	20 .5	35 .8	3 .1	14 .3	4 .1	2 .0	0	0	0	0	0	4 .1	4 .1
MISS ROW%	0	0	0	0	0	0	0	0	0	0	23	1	2	1	1	0	0
CLEAR ROW%	0	304 14.4	0	0	0	0	3 .1	14 .7	4 .2	0	0	0	0	0	0	4 .2	0
TINT ROW%	1 .0	0	91 4.4	148 7.2	20 1.0	35 1.7	0	0	0	2 .1	0	0	0	0	0	0	4 .2

	RA	RC	RD	RE	RH	RK	RR	RU	RY	SA	UN	VA	XY	Y	YK	YL	YM
ROW%	15 .4	3 .1	1 .0	40 1.0	2 .0	18 .4	0	0	0	0	0	0	0	0	0	0	0
MISS ROW%	0	0	0	0	0	0	1	4	1	1	2	1	3	1	503	257	51
CLEAR ROW%	15 .7	3 .1	1 .0	40 1.9	0	0	0	0	0	0	0	0	0	0	0	0	0
TINT ROW%	0	0	0	0	2 .1	18 .9	0	0	0	0	0	0	0	0	0	0	0

	YN	YP	YR	YS	YT	YU	YV	YW	YX	YY	00	22	99
ROW%	0	0	0	0	0	0	0	0	0	0	0	0	0

MISS ROW%	45	70	160	126	35	68	60	65	115	3251	2	1	2
CLEAR ROW%	0	0	0	0	0	0	0	0	0	0	0	0	0
TINT ROW%	0	0	0	0	0	0	0	0	0	0	0	0	0

TWOWAY CROSS-TABULATION   TABLE A-2

4. AGE		584.SNGL¬AGE MISS	(13)	(15)	(16)	(17)	(18)	(19)	(20)	(21)	(22)	(23)	(24)	(25)	(26)	(27)	(28)
N=	9159																
TOTAL=	9173	0	1	16	199	310	395	441	431	477	457	407	369	338	304	276	260
ROW%			.0	.2	2.2	3.4	4.3	4.8	4.7	5.2	5.0	4.4	4.0	3.7	3.3	3.0	2.8
COL%																	
MISS	0	14	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ROW%																	
COL%																	
(16)	526	0	1	16	199	310	0	0	0	0	0	0	0	0	0	0	0
ROW%			.2	3.0	37.8	58.9											
COL%	5.7		100.0	100.0	100.0	100.0											
(19)	1267	0	0	0	0	0	395	441	431	0	0	0	0	0	0	0	0
ROW%							31.2	34.8	34.0								
COL%	13.8						100.0	100.0	100.0								
(22)	1341	0	0	0	0	0	0	0	0	477	457	407	0	0	0	0	0
ROW%										35.6	34.1	30.4					
COL%	14.6									100.0	100.0	100.0					
(25)	1011	0	0	0	0	0	0	0	0	0	0	0	369	338	304	0	0
ROW%													36.5	33.4	30.1		
COL%	11.0												100.0	100.0	100.0		
(28)	780	0	0	0	0	0	0	0	0	0	0	0	0	0	0	276	260
ROW%																35.4	33.3
COL%	8.5															100.0	100.0
(31)	554	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ROW%																	
COL%																	
(34)	448	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ROW%																	
COL%																	
(37)	386	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ROW%																	
COL%																	
(40)	393	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ROW%																	
COL%																	
(43)	366	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ROW%																	
COL%																	
(46)	362	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ROW%																	
COL%																	
(49)	348	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ROW%																	
COL%																	

(52)	298	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ROW%																	
COL%																	
(55)	260	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ROW%																	
COL%																	
(58)	195	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ROW%																	
COL%																	
(61)	167	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ROW%																	
COL%																	
(64)	138	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ROW%																	
COL%																	
(68)	169	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ROW%																	
COL%																	
(75)	150	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ROW%																	
COL%																	
	(29)	(30)	(31)	(32)	(33)	(34)	(35)	(36)	(37)	(38)	(39)	(40)	(41)	(42)	(43)	(44)	(45)
	244	207	183	164	148	143	157	136	133	117	119	141	133	138	116	112	114
ROW%	2.7	2.3	2.0	1.8	1.6	1.6	1.7	1.5	1.5	1.3	1.3	1.5	1.5	1.5	1.3	1.2	1.2
COL%																	
MISS	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ROW%																	
COL%																	
(16)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ROW%																	
COL%																	
(19)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ROW%																	
COL%																	
(22)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ROW%																	
COL%																	
(25)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ROW%																	
COL%																	
(28)	244	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ROW%	31.3																
COL%	100.0																

(31)	0	207	183	164	0	0	0	0	0	0	0	0	0	0	0	0	0
ROW%		37.4	33.0	29.6													
COL%		100.0	100.0	100.0													
(34)	0	0	0	0	148	143	157	0	0	0	0	0	0	0	0	0	0
ROW%					33.0	31.9	35.0										
COL%					100.0	100.0	100.0										
(37)	0	0	0	0	0	0	0	136	133	117	0	0	0	0	0	0	0
ROW%								35.2	34.5	30.3							
COL%								100.0	100.0	100.0							
(40)	0	0	0	0	0	0	0	0	0	0	119	141	133	0	0	0	0
ROW%											30.3	35.9	33.8				
COL%											100.0	100.0	100.0				
(43)	0	0	0	0	0	0	0	0	0	0	0	0	0	138	116	112	0
ROW%														37.7	31.7	30.6	
COL%														100.0	100.0	100.0	
(46)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	114
ROW%																	31.5
COL%																	100.0
(49)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ROW%																	
COL%																	
(52)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ROW%																	
COL%																	
(55)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ROW%																	
COL%																	
(58)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ROW%																	
COL%																	
(61)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ROW%																	
COL%																	
(64)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ROW%																	
COL%																	
(68)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ROW%																	
COL%																	
(75)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ROW%																	
COL%																	
	(46)	(47)	(48)	(49)	(50)	(51)	(52)	(53)	(54)	(55)	(56)	(57)	(58)	(59)	(60)	(61)	(62)

	124	124	123	117	108	110	104	84	79	99	82	78	65	52	51	57	59
ROW%	1.4	1.4	1.3	1.3	1.2	1.2	1.1	.9	.9	1.1	.9	.9	.7	.6	.6	.6	.6
COL%																	
MISS	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ROW%																	
COL%																	
(16)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ROW%																	
COL%																	
(19)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ROW%																	
COL%																	
(22)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ROW%																	
COL%																	
(25)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ROW%																	
COL%																	
(28)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ROW%																	
COL%																	
(31)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ROW%																	
COL%																	
(34)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ROW%																	
COL%																	
(37)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ROW%																	
COL%																	
(40)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ROW%																	
COL%																	
(43)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ROW%																	
COL%																	
(46)	124	124	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ROW%	34.3	34.3															
COL%	100.0	100.0															
(49)	0	0	123	117	108	0	0	0	0	0	0	0	0	0	0	0	0
ROW%			35.3	33.6	31.0												
COL%			100.0	100.0	100.0												
(52)	0	0	0	0	0	110	104	84	0	0	0	0	0	0	0	0	0
ROW%						36.9	34.9	28.2									
COL%						100.0	100.0	100.0									

(55)	0	0	0	0	0	0	0	0	79	99	82	0	0	0	0	0	0
ROW%									30.4	38.1	31.5						
COL%									100.0	100.0	100.0						
(58)	0	0	0	0	0	0	0	0	0	0	0	78	65	52	0	0	0
ROW%												40.0	33.3	26.7			
COL%												100.0	100.0	100.0			
(61)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	51	57	59
ROW%															30.5	34.1	35.3
COL%															100.0	100.0	100.0
(64)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ROW%																	
COL%																	
(68)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ROW%																	
COL%																	
(75)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ROW%																	
COL%																	

	(63)	(64)	(65)	(66)	(67)	(68)	(69)	(70)	(71)	(72)	(73)	(74)	(75)	(76)	(77)	(78)	(79)
	50	56	32	25	33	36	21	26	28	24	21	18	15	12	10	10	13
ROW%	.5	.6	.3	.3	.4	.4	.2	.3	.3	.3	.2	.2	.2	.1	.1	.1	.1
COL%																	
MISS	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ROW%																	
COL%																	
(16)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ROW%																	
COL%																	
(19)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ROW%																	
COL%																	
(22)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ROW%																	
COL%																	
(25)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ROW%																	
COL%																	
(28)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ROW%																	
COL%																	
(31)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ROW%																	
COL%																	

(34)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ROW%																	
COL%																	
(37)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ROW%																	
COL%																	
(40)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ROW%																	
COL%																	
(43)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ROW%																	
COL%																	
(46)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ROW%																	
COL%																	
(49)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ROW%																	
COL%																	
(52)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ROW%																	
COL%																	
(55)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
RUW%																	
COL%																	
(58)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ROW%																	
COL%																	
(61)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ROW%																	
COL%																	
(64)	50	56	32	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ROW%	36.2	40.6	23.2														
COL%	100.0	100.0	100.0														
(68)	0	0	0	25	33	36	21	26	28	0	0	0	0	0	0	0	0
RUW%				14.8	19.5	21.3	12.4	15.4	16.6								
COL%				100.0	100.0	100.0	100.0	100.0	100.0								
(75)	0	0	0	0	0	0	0	0	0	24	21	18	15	12	10	10	13
ROW%										16.0	14.0	12.0	10.0	8.0	6.7	6.7	8.7
COL%										100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
	(80)	(81)	(82)	(83)	(84)	(85)	(86)	(88)	(89)								
	3	11	4	3	1	1	2	1	1								
ROW%	.0	.1	.0	.0	.0	.0	.0	.0	.0								
COL%																	

MISS	0	0	0	0	0	0	0	0	0
ROW%									
COL%									
(16)	0	0	0	0	0	0	0	0	0
ROW%									
COL%									
(19)	0	0	0	0	0	0	0	0	0
ROW%									
COL%									
(22)	0	0	0	0	0	0	0	0	0
ROW%									
COL%									
(25)	0	0	0	0	0	0	0	0	0
ROW%									
COL%									
(28)	0	0	0	0	0	0	0	0	0
ROW%									
COL%									
(31)	0	0	0	0	0	0	0	0	0
ROW%									
COL%									
(34)	0	0	0	0	0	0	0	0	0
ROW%									
COL%									
(37)	0	0	0	0	0	0	0	0	0
ROW%									
COL%									
(40)	0	0	0	0	0	0	0	0	0
ROW%									
COL%									
(43)	0	0	0	0	0	0	0	0	0
ROW%									
COL%									
(46)	0	0	0	0	0	0	0	0	0
ROW%									
COL%									
(49)	0	0	0	0	0	0	0	0	0
ROW%									
COL%									
(52)	0	0	0	0	0	0	0	0	0
ROW%									
COL%									
(55)	0	0	0	0	0	0	0	0	0
ROW%									
COL%									

(58)	0	0	0	0	0	0	0	0	0
ROW%									
COL%									
(61)	0	0	0	0	0	0	0	0	0
ROW%									
COL%									
(64)	0	0	0	0	0	0	0	0	0
ROW%									
COL%									
(68)	0	0	0	0	0	0	0	0	0
ROW%									
COL%									
(75)	3	11	4	3	1	1	2	1	1
ROW%	2.0	7.3	2.7	2.0	.7	.7	1.3	.7	.7
COL%	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0

03273

TWOWAY CROSS-TABULATION TABLE A-3

2. COLOR		4.AGE MISS	(16)	(19)	(22)	(25)	(28)	(31)	(34)	(37)	(40)	(43)	(46)	(49)	(52)	(55)	(58)
N=	4180																
TOTAL=	9173	5	230	544	602	447	357	255	189	176	178	176	168	175	143	123	113
ROW%			5.5	13.0	14.4	10.7	8.5	6.1	4.5	4.2	4.3	4.2	4.0	4.2	3.4	2.9	2.7
COL%																	
MISS	4979	9	296	723	739	564	423	299	259	210	215	190	194	173	155	137	82
EXPECT																	
ROW%																	
COL%																	
CLEAR	2114	4	116	352	369	243	174	114	75	70	83	76	68	75	60	52	55
EXPECT			116	275	304	226	181	129	96	89	90	89	85	89	72	62	57
ROW%			5.5	16.7	17.5	11.5	8.2	5.4	3.5	3.3	3.9	3.6	3.2	3.5	2.8	2.5	2.6
COL%	50.6		50.4	64.7	61.3	54.4	48.7	44.7	39.7	39.8	46.6	43.2	40.5	42.9	42.0	42.3	48.7
TINT	2066	1	114	192	233	204	183	141	114	106	95	100	100	100	83	71	58
EXPECT			114	269	298	221	176	126	93	87	88	87	83	86	71	61	56
ROW%			5.5	9.3	11.3	9.9	8.9	6.8	5.5	5.1	4.6	4.8	4.8	4.8	4.0	3.4	2.8
COL%	49.4		49.6	35.3	38.7	45.6	51.3	55.3	60.3	60.2	53.4	56.8	59.5	57.1	58.0	57.7	51.3

	(61)	(64)	(68)	(75)
	87	57	75	85
ROW%	2.1	1.4	1.8	2.0
COL%				
MISS	80	81	94	65
EXPECT				
ROW%				
COL%				
CLEAR	42	22	26	42
EXPECT	44	29	38	43
ROW%	2.0	1.0	1.2	2.0
COL%	48.3	38.6	34.7	49.4
TINT	45	35	49	43
EXPECT	43	28	37	42
ROW%	2.2	1.7	2.4	2.1
COL%	51.7	61.4	65.3	50.6

TESTS OF INDEPENDENCE STATISTIC SIGNIF DF= 18 N= 4180

	STATISTIC	SIGNIF		
MAXIMUM LIKELIHOOD	131.06	0.	CRAMER'S PHI=	.1762
CHI-SQUARE	129.76	0.	CONTINGENCY COEFF=	.1735

TWOWAY CROSS-TABULATION TABLE A-4

2. COLOR		9.CRASH YR MISS	(4)	(67)	(68)	(69)	(70)	(71)	(72)	(73)	(74)	(75)	(76)	(77)
N=	4159													
TOTAL=	9173	26	1	0	1	106	335	852	908	849	509	370	178	50
ROW%			.0		.0	2.5	8.1	20.5	21.8	20.4	12.2	8.9	4.3	1.2
COL%														
MISS	4728	260	0	45	178	334	631	943	1013	788	421	243	102	30
EXPECT														
ROW%														
COL%														
CLEAR	2115	3	0	0	1	37	151	482	523	430	258	161	57	15
EXPECT			1	0	1	54	170	433	462	432	259	188	91	25
ROW%					.0	1.7	7.1	22.8	24.7	20.3	12.2	7.6	2.7	.7
COL%	50.9				100.0	34.9	45.1	56.6	57.6	50.6	50.7	43.5	32.0	30.0
TINT	2044	23	1	0	0	69	184	370	385	419	251	209	121	35
EXPECT			0	0	0	52	165	419	446	417	250	182	87	25
ROW%			.0			3.4	9.0	18.1	18.8	20.5	12.3	10.2	5.9	1.7
COL%	49.1		100.0			65.1	54.9	43.4	42.4	49.4	49.3	56.5	68.0	70.0

TESTS OF INDEPENDENCE   STATISTIC   SIGNIF   DF= 10   N= 4159

	STATISTIC	SIGNIF		
MAXIMUM LIKELIHOOD	88.696	.0000	CRAMER'S PHI=	.1445
CHI-SQUARE	86.898	.0000	CONTINGENCY COEFF=	.1431

TWOWAY CROSS-TABULATION TABLE A-5

2. CCLOR		29.PRECTYPE MISS	NONE	RAIN	SNOW	HAIL	SLEET	OTHER
N=	4179							
TOTAL=	9173	6	3292	589	268	1	17	12
ROW%			78.8	14.1	6.4	.0	.4	.3
COL%								
MISS	4797	191	3939	610	235	0	6	7
EXPECT								
ROW%								
COL%								
CLEAR	2114	4	1649	294	156	0	10	5
EXPECT			1665	298	136	1	9	6
ROW%			78.0	13.9	7.4		.5	.2
COL%	50.6		50.1	49.9	58.2		58.8	41.7
TINT	2065	2	1643	295	112	1	7	7
EXPECT			1627	291	132	0	8	6
ROW%			79.6	14.3	5.4	.0	.3	.3
COL%	49.4		49.9	50.1	41.8	100.0	41.2	58.3

TESTS OF INDEPENDENCE	STATISTIC	SIGNIF	DF= 5	N= 4179
MAXIMUM LIKELIHOOD	8.9482	.1112	CRAMER'S PHI=	.0452
CHI-SQUARE	8.5259	.1295	CONTINGENCY COEFF=	.0451

TWOWAY CROSS-TABULATION TABLE A-6

2. COLOR		30.PRECRATE MISS	N.A.	LIGHT	MODERT	HEAVY
N=	4039					
TOTAL=	9173	146	3297	443	225	74
ROW%			81.6	11.0	5.6	1.8
COL%						
MISS	4658	330	3941	424	192	101
EXPECT						
ROW%						
COL%						
CLEAR	2047	71	1652	230	121	44
EXPECT			1671	225	114	38
ROW%			80.7	11.2	5.9	2.1
COL%	50.7		50.1	51.9	53.8	59.5
TINT	1992	75	1645	213	104	30
EXPECT			1626	218	111	36
ROW%			82.6	10.7	5.2	1.5
COL%	49.3		49.9	48.1	46.2	40.5

TESTS OF INDEPENDENCE	STATISTIC	SIGNIF	DF= 3	N= 4039
MAXIMUM LIKELIHOOD	3.8688	.2760	CRAMER'S PHI=	.0309
CHI-SQUARE	3.8521	.2779	CONTINGENCY COEFF=	.0309

TWOWAY CROSS-TABULATION TABLE A-7

2. COLOR		31.RD SLIP? MISS	YES	NO
N=	4096			
TOTAL=	9173	89	1005	3091
ROW%			24.5	75.5
COL%				
MISS	4886	102	1077	3809
EXPECT				
ROW%				
COL%				
CLEAR	2083	35	566	1517
EXPECT			511	1572
ROW%			27.2	72.8
COL%	50.9		56.3	49.1
TINT	2013	54	439	1574
EXPECT			494	1519
ROW%			21.8	78.2
COL%	49.1		43.7	50.9

TESTS OF INDEPENDENCE	STATISTIC	SIGNIF	DF= 1	N= 4096
MAXIMUM LIKELIHOOD	15.947	.0001	CRAMER'S PHI=	.0623
CHI-SQUARE	15.908	.0001	CONTINGENCY COEFF=	.0622
BINOMIAL TEST OF SYMMETRY		0.	FISHER EXACT PROB=	.0000

TWOWAY CROSS-TABULATION TABLE A-8

2. COLOR		36.TIME-DAY MISS	(1)	(2)	(3)	(4)
N=	4185					
TOTAL=	9173	0	2260	1673	176	76
ROW%			54.0	40.0	4.2	1.8
COL%						
MISS	4966	22	2509	2108	237	112
EXPECT						
ROW%						
COL%						
CLEAR	2118	0	1125	855	93	45
EXPECT			1144	847	89	38
ROW%			53.1	40.4	4.4	2.1
COL%	50.6		49.8	51.1	52.8	59.2
TINT	2067	0	1135	818	83	31
EXPECT			1116	826	87	38
ROW%			54.9	39.6	4.0	1.5
COL%	49.4		50.2	48.9	47.2	40.8

TESTS OF INDEPENDENCE	STATISTIC	SIGNIF	DF= 3	N= 4185
MAXIMUM LIKELIHOOD	3.4033	.3335	CRAMER'S PHI=	.0285
CHI-SQUARE	3.3887	.3355	CONTINGENCY COEFF=	.0284

TWOWAY CROSS-TABULATION TABLE A-9

2. COLOR		37.VIS MISS	LMTN NONE	DARK	FOG	SMOKE	WNDCON	GLARE	OTHER	RAIN	SNOW
N=	4162										
TOTAL=	9173	23	3533	295	81	3	14	50	17	96	73
ROW%			84.9	7.1	1.9	.1	.3	1.2	.4	2.3	1.8
COL%											
MISS	4726	262	4002	333	83	3	24	89	31	106	55
EXPECT											
ROW%											
COL%											
CLEAR	2110	8	1760	161	50	2	8	27	12	50	40
EXPECT			1791	150	41	2	7	25	9	49	37
ROW%			83.4	7.6	2.4	.1	.4	1.3	.6	2.4	1.9
COL%	50.7		49.8	54.6	61.7	66.7	57.1	54.0	70.6	52.1	54.8
TINT	2052	15	1773	134	31	1	6	23	5	46	33
EXPECT			1742	145	40	1	7	25	8	47	36
ROW%			86.4	6.5	1.5	.0	.3	1.1	.2	2.2	1.6
COL%	49.3		50.2	45.4	38.3	33.3	42.9	46.0	29.4	47.9	45.2

TESTS OF INDEPENDENCE STATISTIC SIGNIF DF= 8 N= 4162

TESTS OF INDEPENDENCE	STATISTIC	SIGNIF		
MAXIMUM LIKELIHOOD	10.968	.2035	CRAMER'S PHI=	.0510
CHI-SQUARE	10.829	.2116	CONTINGENCY COEFF=	.0509

TWOWAY CROSS-TABULATION TABLE A-10

2. CCLOR		115.MFR DIV MISS	(10)	BUICK	CADLAC	CHEVLT	OLDS	PONTAC	GMCT&C	LEKTRO	OPEL	VAUXHL	FORD	LINMER	KRYSLR	DODGE	IMPRL
N=	4156																
TOTAL=	9173	29	0	249	91	1097	298	337	13	1	16	0	1067	237	40	295	3
ROW%				6.0	2.2	26.4	7.2	8.1	.3	.0	.4		25.7	5.7	1.0	7.1	.1
COL%																	
MISS	4422	566	1	151	54	1023	209	308	26	0	66	1	1237	307	67	361	6
EXPECT																	
ROW%																	
COL%																	
CLEAR	2091	27	0	33	0	587	66	111	13	0	14	0	711	110	6	174	0
EXPECT			0	125	46	552	150	170	7	1	8	0	537	119	20	148	2
ROW%				1.6		28.1	3.2	5.3	.6		.7		34.0	5.3	.3	8.3	
COL%	50.3			13.3		53.5	22.1	32.9	100.0		87.5		66.6	46.4	15.0	59.0	
TINT	2065	2	0	216	91	510	232	226	0	1	2	0	356	127	34	121	3
EXPECT			0	124	45	545	148	167	6	0	8	0	530	118	20	147	1
ROW%				10.5	4.4	24.7	11.2	1C.9		.0	.1		17.2	6.2	1.6	5.9	.1
COL%	49.7			86.7	100.0	46.5	77.9	67.1		100.0	12.5		33.4	53.6	85.0	41.0	100.0

	PLYMTH	DESOTO	AMC
	314	0	98
ROW%	7.6		2.4
COL%			
MISS	365	1	239
EXPECT			
ROW%			
COL%			
CLEAR	200	0	66
EXPECT	158	0	49
ROW%	9.6		3.2
COL%	63.7		67.3
TINT	114	0	32
EXPECT	156	0	49
ROW%	5.5		1.5
COL%	36.3		32.7

TESTS OF INDEPENDENCE	STATISTIC	SIGNIF	DF= 14	N= 4156
MAXIMUM LIKELIHOOD	642.21	0.	CRAMER'S PHI=	.3711
CHI-SQUARE	572.27	0.	CONTINGENCY COEFF=	.3479

TWOWAY CROSS-TABULATION TABLE A-11

2. CCLOR		117.CV¬MODEL MISS	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)
N=	4185																
TOTAL=	9173	0	806	1024	211	49	111	345	114	757	33	26	75	164	1	36	9
ROW%			19.3	24.5	5.0	1.2	2.7	8.2	2.7	18.1	.8	.6	1.8	3.9	.0	.9	.2
COL%																	
MISS	4987	1	841	1103	133	19	95	464	66	704	481	54	146	261	0	38	23
EXPECT																	
ROW%																	
COL%																	
CLEAR	2118	0	402	294	1	32	4	184	26	592	28	3	56	133	0	33	5
EXPECT			408	518	107	25	56	175	58	383	17	13	38	83	1	18	5
ROW%			19.0	13.9	.0	1.5	.2	8.7	1.2	28.0	1.3	.1	2.6	6.3		1.6	.2
COL%	50.6		49.9	28.7	.5	65.3	3.6	53.3	22.8	78.2	84.8	11.5	74.7	81.1		91.7	55.6
TINT	2067	0	404	730	210	17	107	161	88	165	5	23	19	31	1	3	4
EXPECT			398	506	104	24	55	170	56	374	16	13	37	81	0	18	4
ROW%			19.5	35.3	10.2	.8	5.2	7.8	4.3	8.0	.2	1.1	.9	1.5	.0	.1	.2
COL%	49.4		50.1	71.3	99.5	34.7	96.4	46.7	77.2	21.8	15.2	88.5	25.3	18.9	100.0	8.3	44.4

	(16)	(17)	(18)	(19)	(20)	(22)	(23)
	21	21	371	4	1	6	0
ROW%	.5	.5	8.9	.1	.0	.1	
COL%							
MISS	34	44	379	79	14	8	1
EXPECT							
ROW%							
COL%							
CLEAR	16	11	291	4	0	3	0
EXPECT	11	11	188	2	1	3	0
ROW%	.8	.5	13.7	.2		.1	
COL%	76.2	52.4	78.4	100.0		50.0	
TINT	5	10	80	0	1	3	0
EXPECT	10	10	183	2	0	3	0
ROW%	.2	.5	3.9		.0	.1	
COL%	23.8	47.6	21.6		100.0	50.0	

TESTS OF INDEPENDENCE	STATISTIC	SIGNIF	DF= 20	N= 4185
MAXIMUM LIKELIHOOD	1181.6	0.	CRAMER'S PHI=	.4981
CHI-SQUARE	1038.5	0.	CONTINGENCY COEFF=	.4459

TWOWAY CROSS-TABULATION TABLE A-12

2. COLOR		119.MODEL YR (46)	(48)	(49)	(53)	(55)	(56)	(57)	(58)	(59)	(60)	(61)	(62)	(63)	(64)	(65)	(66)
N=	4185																
TOTAL=	9173	0	0	0	0	0	0	0	0	1	1	1	0	2	7	11	15
ROW%										.0	.0	.0		.0	.2	.3	.4
COL%																	
MISS	4988	1	1	1	4	2	14	7	4	15	17	24	51	75	74	119	111
EXPECT																	
ROW%																	
COL%																	
CLEAR	2118	0	0	0	0	0	0	0	0	0	0	0	0	1	1	5	3
EXPECT		0	0	0	0	0	0	0	0	1	1	1	0	1	4	6	8
ROW%														.0	.0	.2	.1
COL%	50.6													50.0	14.3	45.5	20.0
TINT	2067	0	0	0	0	0	0	0	0	1	1	1	0	1	6	6	12
EXPECT		0	0	0	0	0	0	0	0	0	0	0	0	1	3	5	7
ROW%										.0	.0	.0		.0	.3	.3	.6
COL%	49.4									100.0	100.0	100.0		50.0	85.7	54.5	80.0

	(67)	(68)	(69)	(70)	(71)	(72)	(73)	(74)	(75)	(76)	(77)
	32	118	268	725	788	744	614	502	246	99	11
ROW%	.8	2.8	6.4	17.3	18.8	17.8	14.7	12.0	5.9	2.4	.3
COL%											
MISS	256	449	548	795	790	729	453	268	136	37	7
EXPECT											
ROW%											
COL%											
CLEAR	8	42	84	400	493	387	320	252	85	34	3
EXPECT	16	60	136	367	399	377	311	254	124	50	6
ROW%	.4	2.0	4.0	18.9	23.3	18.3	15.1	11.9	4.0	1.6	.1
COL%	25.0	35.6	31.3	55.2	62.6	52.0	52.1	50.2	34.6	34.3	27.3
TINT	24	76	184	325	295	357	294	250	161	65	8
EXPECT	16	58	132	358	389	367	303	248	122	49	5
ROW%	1.2	3.7	8.9	15.7	14.3	17.3	14.2	12.1	7.8	3.1	.4
COL%	75.0	64.4	68.7	44.8	37.4	48.0	47.9	49.8	65.4	65.7	72.7

TESTS OF INDEPENDENCE	STATISTIC	SIGNIF	DF= 17	N= 4185
MAXIMUM LIKELIHOOD	166.39	0.	CRAMER'S PHI=	.1967
CHI-SQUARE	161.86	0.	CONTINGENCY COEFF=	.1930

TWOWAY CROSS-TABULATION <1> LIGHT:DAY TABLE A-12-A

2. COLOR		119.MODEL YR (49)	(53)	(55)	(56)	(57)	(58)	(59)	(60)	(61)	(62)	(63)	(64)	(65)	(66)	(67)	(68)
N=	2260																
TOTAL=	4769	0	0	0	0	0	0	1	0	1	0	2	5	8	10	20	68
ROW%								.0		.0		.1	.2	.4	.4	.9	3.0
COL%																	
MISS	2509	1	1	1	6	1	1	10	9	14	32	49	37	77	64	130	224
EXPECT																	
ROW%																	
COL%																	
CLEAR	1125	0	0	0	0	0	0	0	0	0	0	1	1	4	1	6	24
EXPECT		0	0	0	0	0	0	0	0	0	0	1	2	4	5	10	34
ROW%												.1	.1	.4	.1	.5	2.1
COL%	49.8											50.0	20.0	50.0	10.0	30.0	35.3
TINT	1135	0	0	0	0	0	0	1	0	1	0	1	4	4	9	14	44
EXPECT		0	0	0	0	0	0	1	0	1	0	1	3	4	5	10	34
ROW%								.1		.1		.1	.4	.4	.8	1.2	3.9
COL%	50.2							100.0		100.0		50.0	80.0	50.0	90.0	70.0	64.7

	(69)	(70)	(71)	(72)	(73)	(74)	(75)	(76)	(77)
	165	398	441	379	330	252	120	54	6
ROW%	7.3	17.6	19.5	16.8	14.6	11.2	5.3	2.4	.3
COL%									
MISS	251	375	407	374	238	118	67	18	4
EXPECT									
ROW%									
COL%									
CLEAR	50	224	276	192	159	123	43	19	2
EXPECT	82	198	220	189	164	125	60	27	3
ROW%	4.4	19.9	24.5	17.1	14.1	10.9	3.8	1.7	.2
COL%	30.3	56.3	62.6	50.7	48.2	48.8	35.8	35.2	33.3
TINT	115	174	165	187	171	129	77	35	4
EXPECT	83	200	221	190	166	127	60	27	3
ROW%	10.1	15.3	14.5	16.5	15.1	11.4	6.8	3.1	.4
COL%	69.7	43.7	37.4	49.3	51.8	51.2	64.2	64.8	66.7

TESTS OF INDEPENDENCE	STATISTIC	SIGNIF	DF= 16	N= 2260
MAXIMUM LIKELIHOOD	98.036	.0000	CRAMER'S PHI=	.2048
CHI-SQUARE	94.752	.0000	CONTINGENCY COEFF=	.2006

TWOWAY CROSS-TABULATION <2> LIGHT:NIGHT TABLE A-12-B

2. COLOR		119.MODEL YR (46)	(48)	(53)	(55)	(56)	(57)	(58)	(59)	(60)	(61)	(62)	(63)	(64)	(65)	(66)	(67)
N=	1673																
TOTAL=	3781	0	0	0	0	0	0	0	0	1	0	0	0	2	3	4	9
ROW%										.1				.1	.2	.2	.5
COL%																	
MISS	2108	1	1	3	1	8	5	2	5	8	9	16	21	29	36	40	106
EXPECT																	
ROW%																	
COL%																	
CLEAR	855	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1
EXPECT		0	0	0	0	0	0	0	0	1	0	0	0	1	2	2	5
ROW%															.1	.1	.1
COL%	51.1														33.3	25.0	11.1
TINT	818	0	0	0	0	0	0	0	0	1	0	0	0	2	2	3	8
EXPECT		0	0	0	0	0	0	0	0	0	0	0	0	1	1	2	4
ROW%										.1				.2	.2	.4	1.0
COL%	48.9									100.0				100.0	66.7	75.0	88.9

	(68)	(69)	(70)	(71)	(72)	(73)	(74)	(75)	(76)	(77)
	42	90	276	305	310	250	220	116	41	4
ROW%	2.5	5.4	16.5	18.2	18.5	14.9	13.2	6.9	2.5	.2
COL%										
MISS	185	252	352	325	303	186	128	66	17	3
EXPECT										
ROW%										
COL%										
CLEAR	16	28	149	189	162	142	112	40	13	1
EXPECT	21	46	141	156	158	128	112	59	21	2
ROW%	1.9	3.3	17.4	22.1	18.9	16.6	13.1	4.7	1.5	.1
COL%	38.1	31.1	54.0	62.0	52.3	56.8	50.9	34.5	31.7	25.0
TINT	26	62	127	116	148	108	108	76	28	3
EXPECT	21	44	135	149	152	122	108	57	20	2
ROW%	3.2	7.6	15.5	14.2	18.1	13.2	13.2	9.3	3.4	.4
COL%	61.9	68.9	46.0	38.0	47.7	43.2	49.1	65.5	68.3	75.0

TESTS OF INDEPENDENCE	STATISTIC	SIGNIF	DF= 14	N= 1673
MAXIMUM LIKELIHOOD	69.262	.0000	CRAMER'S PHI=	.1993
CHI-SQUARE	66.432	.0000	CONTINGENCY COEFF=	.1954

TWOWAY CROSS-TABULATION TABLE A-13

2. COLOR		136.LIGHT MISS	DAY	NIGHT
N=	3933			
TOTAL=	9173	252	2260	1673
ROW%			57.5	42.5
COL%				
MISS	4617	371	2509	2108
EXPECT				
ROW%				
COL%				
CLEAR	1980	138	1125	855
EXPECT			1138	842
ROW%			56.8	43.2
COL%	50.3		49.8	51.1
TINT	1953	114	1135	818
EXPECT			1122	831
ROW%			58.1	41.9
COL%	49.7		50.2	48.9

TESTS OF INDEPENDENCE	STATISTIC	SIGNIF	DF= 1	N= 3933
MAXIMUM LIKELIHOOD	.67725	.4105	CRAMER'S PHI=	.0131
CHI-SQUARE	.67722	.4105	CONTINGENCY COEFF=	.0131
BINOMIAL TEST OF SYMMETRY		.0000	FISHER EXACT PROB=	.2150

TWOWAY CROSS-TABULATION TABLE A-14

2. CCLOR		338.WD CRKD? MISS	YES	NO
N=	4181			
TOTAL=	9173	4	2163	2018
ROW%			51.7	48.3
COL%				
MISS	4927	61	3292	1635
EXPECT				
ROW%				
COL%				
CLEAR	2117	1	1066	1051
EXPECT			1095	1022
ROW%			50.4	49.6
COL%	50.6		49.3	52.1
TINT	2064	3	1097	967
EXPECT			1068	996
ROW%			53.1	46.9
COL%	49.4		50.7	47.9

TESTS OF INDEPENDENCE	STATISTIC	SIGNIF	DF= 1	N= 4181
MAXIMUM LIKELIHOOD	3.2700	.0706	CRAMER'S PHI=	.0280
CHI-SQUARE	3.2695	.0706	CONTINGENCY COEFF=	.0280
BINOMIAL TEST OF SYMMETRY		.3316	FISHER EXACT PROB=	.0378

TWOWAY CROSS-TABULATION TABLE A-15

2. COLOR		339.WD BRKN? MISS	YES	NO	N.A.
N=	4173				
TOTAL=	9173	12	337	3836	0
ROW%			8.1	91.9	
COL%					
MISS	4856	132	1364	3489	3
EXPECT					
ROW%					
COL%					
CLEAR	2110	8	150	1960	0
EXPECT			170	1940	0
ROW%			7.1	92.9	
COL%	50.6		44.5	51.1	
TINT	2063	4	187	1876	0
EXPECT			167	1896	0
ROW%			9.1	90.9	
COL%	49.4		55.5	48.9	

TESTS OF INDEPENDENCE	STATISTIC	SIGNIF	DF= 1	N= 4173
MAXIMUM LIKELIHOOD	5.3807	.0204	CRAMER'S PHI =	.0359
CHI-SQUARE	5.3731	.0205	CONTINGENCY COEFF=	.0359
BINOMIAL TEST OF SYMMETRY		0.	FISHER EXACT PROB=	.0118

TWOWAY CROSS-TABULATION TABLE A-16

2. COLOR		361.AIR COND MISS	YES	NO
N=	4179			
TOTAL=	9173	6	2479	1700
ROW%			59.3	40.7
COL%				
MISS	4768	220	2539	2229
EXPECT				
ROW%				
COL%				
CLEAR	2115	3	800	1315
EXPECT			1255	860
ROW%			37.8	62.2
COL%	50.6		32.3	77.4
TINT	2064	3	1679	385
EXPECT			1224	840
ROW%			81.3	18.7
COL%	49.4		67.7	22.6

TESTS OF INDEPENDENCE STATISTIC SIGNIF DF= 1 N= 4179

TESTS OF INDEPENDENCE	STATISTIC	SIGNIF		
MAXIMUM LIKELIHOOD	855.72	0.	CRAMER'S PHI=	.4429
CHI-SQUARE	819.94	0.	CONTINGENCY COEFF=	.4050
BINOMIAL TEST OF SYMMETRY		.0000	FISHER EXACT PROB=	0.

TWOWAY CROSS-TABULATION TABLE A-17

2. COLOR		516.BRD OCCU MISS	WHITE	BLUE	FARM	SERVIC	HCUSWF	STUDNT	MILTRY	RETIRD	UNEMPL
N=	1498										
TOTAL=	9173	2697	575	351	10	152	123	151	24	73	29
ROW%			38.6	23.6	.7	10.2	8.3	10.1	1.6	4.9	1.9
COL%											
MISS	2112	2876	732	534	17	190	129	320	39	76	75
EXPECT											
ROW%											
COL%											
CLEAR	694	1424	227	213	7	67	49	66	10	36	19
EXPECT			268	164	5	71	57	70	11	34	14
ROW%			32.7	30.7	1.0	9.7	7.1	9.5	1.4	5.2	2.7
COL%	46.6		39.5	60.7	70.0	44.1	39.8	43.7	41.7	49.3	65.5
TINT	794	1273	348	138	3	85	74	85	14	37	10
EXPECT			307	187	5	81	66	81	13	39	15
ROW%			43.8	17.4	.4	10.7	9.3	10.7	1.8	4.7	1.3
COL%	53.4		60.5	39.3	30.0	55.9	60.2	56.3	58.3	50.7	34.5

TESTS OF INDEPENDENCE	STATISTIC	SIGNIF	DF= 8	N= 1488
MAXIMUM LIKELIHOOD	49.898	.0000	CRAMER'S PHI=	.1827
CHI-SQUARE	49.669	.0000	CONTINGENCY COEFF=	.1797

TWOWAY CROSS-TABULATION TABLE A-18

2. CCLOR		536.RESPBLTY MISS	MOST	SECOND	THIRD	FOURTH	FIFTH	SIXTH
N=	4025							
TOTAL=	9173	160	2450	1497	67	8	2	1
ROW%			60.9	37.2	1.7	.2	.0	.0
COL%								
MISS	4511	477	3000	1399	104	5	3	0
EXPECT								
ROW%								
COL%								
CLEAR	2038	80	1289	715	33	1	0	0
EXPECT			1241	758	34	4	1	1
ROW%			63.2	35.1	1.6	.0		
COL%	50.6		52.6	47.8	49.3	12.5		
TINT	1987	80	1161	782	34	7	2	1
EXPECT			1209	739	33	4	1	0
ROW%			58.4	39.4	1.7	.4	.1	.1
COL%	49.4		47.4	52.2	50.7	87.5	100.0	100.0

TESTS OF INDEPENDENCE STATISTIC SIGNIF DF= 5 N= 4025

TESTS OF INDEPENDENCE	STATISTIC	SIGNIF		
MAXIMUM LIKELIHOOD	18.280	.0026	CRAMER'S PHI=	.0641
CHI-SQUARE	16.557	.0054	CONTINGENCY COEFF=	.0640

TWOWAY CROSS-TABULATION TABLE A-19

2. COLOR		590.SEX MISS	MALE	FEMALE
N=	4184			
TOTAL=	9173	1	2824	1360
ROW%			67.5	32.5
COL%				
MISS	4980	8	3647	1333
EXPECT				
ROW%				
COL%				
CLEAR	2117	1	1409	708
EXPECT			1429	688
ROW%			66.6	33.4
COL%	50.6		49.9	52.1
TINT	2067	0	1415	652
EXPECT			1395	672
ROW%			68.5	31.5
COL%	49.4		50.1	47.9

TESTS OF INDEPENDENCE	STATISTIC	SIGNIF	DF= 1	N= 4184
MAXIMUM LIKELIHOOD	1.7218	.1895	CRAMER'S PHI=	.0203
CHI-SQUARE	1.7214	.1895	CONTINGENCY COEFF=	.0203
BINOMIAL TEST OF SYMMETRY		.0000	FISHER EXACT PROB=	.1005