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RAIL-HIGHWAY CROSSING HAZARD PREDICTION RESEARCH RESULTS

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16. Abstract

This document presents techniques for constructing and evaluating railroad grade crossing hazard indexes. Hazard indexes are objective formulas for comparing or ranking crossings according to relative hazard or for calculating absolute hazard (conditional expected frequency of grade crossing accidents) on an individual crossing basis. Relative and absolute hazard indexes are constructed and compared in performance with some hazard indexes in general use. The DOT-AAR crossing inventory for all public crossings in the United States and the FRA accident data base for 1975 are used. Various measures and displays of performance of hazard indexes in predicting the hazard of crossings as functions of their inventory characteristics and as manifest in the U.S. accident experience of 1975 are given. The levels of performance that may be expected of various hazard indexes in various situations are given. Relative and absolute hazard indexes constructed on this project are exhibited which outperform other hazard indexes tested. Means for shaping a relative hazard index into an absolute hazard index are given. An introductory discussion is provided on the use of accident history in hazard indexes. Preliminary estimates are given of some of the parameters involved in that discussion. Theoretical aspects of this report include some discussions of nonlinear regression and nonlinear discriminant analysis as well as some aspects of empirical Bayesian statistics.

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PREFACE

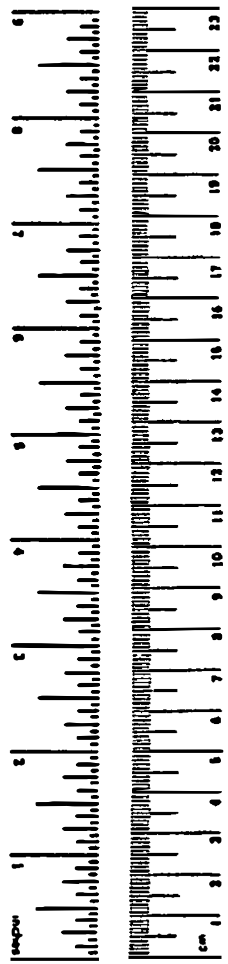
The author wishes to acknowledge the contribution of James Guarente of Kentron Hawaii Limited who did the programming and data handling for this project. Mr. Guarente also was responsible for many day-to-day decisions on the course of the analysis, and assisted in determining the direction of this study. Because of his direct involvement with the actual analysis and experimentation, Mr. Guarente has written one of the sections of this report entitled "Course of Experimentation."

The author is also indebted to B. George and R. Snow of the Federal Railroad Administration for their support and guidance, and to J. Hitz, E. Farr, and R. Hinckley of TSC for useful suggestions throughout the course of this work.

METRIC CONVERSION FACTORS

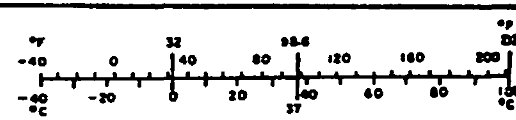
Approximate Conversions to Metric Measures

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



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

The Federal Railroad Administration (FRA), in accordance with the Federal Railroad Safety Act of 1970, is investigating problems of railroad crossing safety improvement. In pursuit of the related studies, the FRA sought the services of the Transportation Systems Center (TSC) in selecting, evaluating, and developing hazard indexes, formulas used to estimate from available quantified information the hazards, or relative hazards, of train/vehicle accidents at railroad crossings. The TSC, currently engaged in a Grade Crossing Funding Allocation Project which also requires state-of-the-art hazard indexes of the highest selective and predictive capabilities, complied with the FRA request. Thus, it has provided this document report on a study of hazard indexes as evaluated and constructed on the basis of FRA data. The report distinguishes between, develops, and evaluates the following hazard indexes:

- <u>Relative</u> hazard indexes, for <u>ranking</u> crossings according to relative hazard.
- <u>Absolute</u> hazard indexes, for providing an estimate equal to, or at least proportional to, expected accident frequency at the individual crossings.

Comparisons of several previously developed hazard indexes are given. Of these, the New Hampshire and Peabody-Dimmick are widely used. Selected Coleman-Stewart formulas for three specific warning device classes (crossbucks, flashing lights, and automatic gates) have also been evaluated.

New hazard indexes with improved prediction capability have been developed, and are reported on. The performance of these new indexes is compared in detail with the previously proposed formulas. A number of techniques for constructing hazard indexes have been explored, and a particularly effective technique employing non-linear logistic discriminant techniques was selected for the final models reported on. This method is described in detail, and is suggested as the tool to form the basis of further analysis or development.

The major results of the study include:

1. Techniques and methodology for producing, comparing, and evaluating hazard indexes
2. New hazard indexes for three warning device classes (crossbucks, flashing lights, and gates)
3. Detailed comparisons of the performance of hazard indexes.

Out of these have come specific results:

a. Volume factors (average daily vehicle volume and average daily train volume) account for 90-95 percent of the predictive power obtainable from the factors studied, excluding accident history at present. (See below.)

b. The simple New Hampshire formula (relative hazard proportional to vehicular volume times train volume) is nearly as effective as other volume-only formulas for relative hazard. A procedure and formula are given for converting this to an absolute hazard index (proportional to expected accident frequency). The New Hampshire formula is useful for its combination of power and simplicity.

c. For some uses, and in certain respects described in the report, the TSC formulas exhibited greater selectivity of hazardous crossings (performance as a relative hazard index) than other formulas tested. This is evidenced, for example, by comparing the ten percent most hazardous crossings selected by the TSC formula with the ten percent most hazardous set selected by the New Hampshire formula (crossbuck case). The TSC ten percent set, as determined from the FRA data bases, contains three percent more of the total accidents than the New Hampshire ten percent set. This is statistically significant.

The TSC formulas developed and reported on here may be useful when an absolute hazard index or expected frequency of accidents is needed, as in the funding allocation work. For this purpose, both comprehensive and volume-only formulas are given. The performance of absolute hazard indexes is exhibited in special plots.

d. Because of the large amount of experimentation done and the relatively small improvements in power factors (PF) obtainable, it would appear that the ultimately attainable power factors are not far from those obtained in this study. (The power factor at X% multiplied by X% gives the percent of accidents at the X% most hazardous crossings according to the given hazard index. Thus, if the 5% power factor is 4, then 5% of the crossings have 20% of the accidents.) The following power factors are quoted to illustrate the performance measures attained in a few instances taken as examples.

Crossbucks Power Factors

% Crossings	PF New Hampshire	PF TSC
1	6.80	7.86
2	6.17	5.90
6	4.76	4.92
10	3.83	4.10
20	2.88	3.01
40	2.03	2.03

Thus, this table says that according to the New Hampshire formula, the 10% most hazardous crossings had about 38% of the accidents, while the 10% most hazardous crossings according to the TSC formula had about 41% (the 3% difference was alluded to above) of the accidents, all figured on the FRA data bases (1975 accidents). More complete information and similar information for other warning device classes is presented in the body of this report.

Suggestions for further work are also given. In particular, in one of the appendixes (Appendix H) a proposed means is developed for incorporating accident history at an individual crossing along with crossing characteristics into a hazard index, and some preliminary results are given. The techniques of this appendix are currently being used in the FY79 effort at TSC to produce accident history dependent hazard indexes.

Addendum to Summary

Since this report was written, some power factors have been run using the same best TSC and New Hampshire models discussed in this report, but with the 1976 accident data and the inventory data of May 1978 (about 9 months later than the date of the inventory data used in this report). In order not to delay publication, results are presented only in this summary for this report. In general, the results were quite comparable to the results reported on in detail for the earlier date presented in this report, the comparability holding for all three warning classes. Partial results corresponding to the table given just above are given in the following table:

Crossbucks Power Factors
(1976 accidents)

% Crossings	PF New Hampshire	PF TSC
1	7.11	7.73
2	6.11	6.57
6	4.43	4.71
10	3.72	3.92
20	2.78	2.91
40	1.98	2.03

The observed results confirm the stability of relative performance for the TSC models when used on accident data for a different year from that of the data used in their construction. The power factors for the other two warning device classes similarly confirmed this stability.

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GLOSSARY

ABSOLUTE HAZARD INDEX -- A hazard index which is also proportional to expected number of accidents per year. (See HAZARD INDEX, PROBABILITY OF ACCIDENT, and EXPECTED FREQUENCY OF ACCIDENTS.) (See Sections 1, 2.3, and 4.3.)

ACCIDENT -- "A public grade crossing accident/incident is any impact between railroad on-track equipment and an automobile, bus, truck, motorcycle, bicycle, farm vehicle, or pedestrian, regardless of whether it resulted in any casualties or damage." (See Reference 3.) The ratio of fatalities to accidents in the year 1975 was approximately 0.105. (See Section 1 and Appendix F.)

COLEMAN-STEWART MODEL -- One of several specific hazard indexes. (See Appendix B and Reference 2.)

EMPIRICAL OPERATING CHARACTERISTICS (EOC) -- A table giving power factors, cumulative accidents at various percentages of hazardous crossings, etc. Also a graph of percent accidents versus percent crossings. (See also POWER FACTOR.) (See Sections 2 and 4 and Appendix C.)

EOC -- See EMPIRICAL OPERATING CHARACTERISTIC.

EXPECTED FREQUENCY OF ACCIDENTS (or expected number of accidents) -- For a given value of the hazard index, the expected number of accidents to occur at a given crossing in a given year. Related approximately to probability of accident, p, by f = p/1-p. (See PROBABILITY OF ACCIDENT.) (See Sections 2.3 and 4.3.)

HAZARD INDEX (or hazard function, hazard model). A formula relating relative hazard of accident to quantifiable crossing characteristics. The higher the hazard index the higher the probability of accidents (if the hazard index holds good). If the hazard index is also proportional to probability of accident, then it is an absolute hazard index. (See also ABSOLUTE HAZARD INDEX.) (See Section 1.)

ITERATED WEIGHTED LOGISTIC REGRESSION -- Each of the component parts of this expression has a common meaning in statistical analysis. They are combined in this project to produce a technique especially adapted for producing hazard models. (See Section 2.2 and Appendix A.)

NEW HAMPSHIRE MODEL -- A very simple hazard index (often given other names) which states that for a given warning device class the (relative) hazard increases with the product of the average vehicular volume and the average train volume. This gives a good relative hazard index, but not a good absolute hazard index (except by modification). (See Section 4.1 and Appendix B.)

NON-VOLUME VARIABLES -- All crossing characteristics not derived only from volume variables, e.g., number of tracks, train speed, number of night trains, etc. (See also VOLUME VARIABLES.) (See Sections 1 and 3.)

PEABODY-DIMMICK MODEL -- A hazard index developed many years ago depending only on vehicular volume and train volume for a crossing of a given warning device class. (See Section 4.1, Appendix B, and Reference 11.)

POWER FACTOR -- The fraction of accidents occurring at a given fraction of the most hazardous crossings. If the 5 percent factor is 4, then the 5 percent most hazardous (according to a given hazard index) crossings have 20 percent of the accidents. (See Section 2 and Appendix C.)

POWER FACTOR FUNCTION -- An analytic representation of the EOC by means of a function which fits the observed functional relation of power factor to fraction of crosisngs. (It is used for a given warning device class and hazard index.) It is usually of the form $\log \rho = a(\log \lambda)^b$, where ρ is the $\lambda \times 100\%$ power factor, and λ is a given fraction of the crossings. (See also POWER FACTOR.) (See Sections 2.3 and 4.1 and Appendix C.)

PROBABILITY OF ACCIDENT -- For a given value of a given hazard index the probability, p, of a crossing (with this value for the hazard index) experiencing an accident in a given year. (See EXPECTED FREQUENCY OF ACCIDENTS.)

TSC COMPREHENSIVE MODEL -- A hazard index, for each warning device class constructed in this project, which uses the TSC volume model as a base, and which includes non-volume variables as well. The best comprehensive models for each warning device class are given in Appendix B. The best comprehensive models are of logistic construction, and easily yield an absolute hazard index.

TSC VOLUME MODEL -- A hazard index for each warning device class, constructed in this project, using only volume variables. Best volume models are of logistic construction, and yield absolute hazard as well. (See Sections 4.1 and 4.4 and Appendix B, etc.)

VOLUME REGRESSION -- Any hazard index optimized as a function of volume variables only, whether constructed by linear regression, logistic discriminant analysis, etc. It has been observed that apparently 90-95 percent of the predictive power of any hazard index is accounted for by its volume dependence. (See also VOLUME VARIABLES.) (See Sections 2 and 3.)

VOLUME VARIABLES -- Those variables and functions, entering any hazard index, which depend only on C, the average total daily vehicular volume, and T, the average total daily train volume. Only total traffic of either kind is included. By this definition, any breakdown such as day/night, through/switch, car/truck involves non-volume variables. (See also NON-VOLUME VARIABLES.)

WARNING DEVICE CLASS -- A class of crossings determined by the warning devices for highway vehicles. The most effective device present at each crossing in the class gives its name to the class. Thus, each crossing in the warning device class designated "crossbucks" has no active warning equipment, but has the standard crossbucks to warn highway traffic. The separate and disjoint warning device classes "crossbucks," "flashing lights," and "automatic gates" together encompass about 90 percent of all public grade crossings accounting for over 90 percent of all grade crossing accidents, and are the focus of this report. All the analyses and constructions in this report are disaggregated by warning device class. The term "warning device class" refers to essentially the same classes of crossings as does the term "protection class" used in some previous literature. (See Table F-2, LOC 47.)

1. INTRODUCTION

1.1 HAZARD INDEXES

There has been long and continued interest in objective formulas for comparing individual railroad grade crossings with respect to accident hazard. These formulas are usually relatively simple functions of easily quantifiable characteristics of the grade crossing, and are called "hazard indexes." (See References 1, 2, 5, 8, and 12.)

An example of a hazard index in common use is the so-called New Hampshire formula:

$$H = K_p \cdot CT$$

where C is the average daily vehicular traffic volume at the crossing, and T is the average number of trains per day. K_p is constant, differing for each warning device class. As will be shown in this report, the New Hampshire formula can be of value for comparing crossings of the same warning device class with respect to relative hazard. The means of comparing formulas in their ability to predict hazard will be shown and these methods will be used with the comprehensive data (all to be described presently) to make relative assessments of the hazard ranking efficiency of various formulas. (The New Hampshire formula is not the best in this regard, but is a good example because it is surprisingly efficient, given its simplicity.

A hazard index, as referred to above, gives a relative indication of hazard. An absolute indication of hazard is a quantity which is proportional to expected frequency of accidents per year (at a crossing with the characteristics represented in the formula). The New Hampshire formula, as stated above, is good as a relative hazard index only. Other formulas, which are good as absolute hazard indexes, will be covered, as will the method of obtaining an absolute hazard index from a relative hazard index.

Relative hazard indexes are used for ranking and comparing grade crossings as to their hazard level. One practical use would be in preliminary selection of a group of crossings (out of some population) for closer examination in order to select from this group a smaller group for improvement, i.e., upgrading of warning device class.

For certain more analytic applications, especially those carried out on a large scale, it may not be enough to have a relative hazard index; rather, an absolute hazard index is needed. For example, in calculating benefit/cost ratios on a per crossing basis, the benefits may be based on the expected (predicted) accident frequency at the particular crossing, and this is given only by an absolute hazard index.

Construction of a superior relative hazard index is the more difficult part. "Shaping" the hazard function to an absolute hazard index is easier and more straightforward.

Mathematically, the term "relative hazard index" can be defined in terms of "absolute hazard index" (even though the calculation may go the other way). An absolute hazard index is any quantity directly proportional to expected frequency of accident. A relative hazard index is any monotonic (always increasing) function of an absolute hazard index. From almost every intuitive, computational, and practical point of view, however, the concept of relative hazard index may be thought of as prior. The relative hazard index indicates which crossings are more hazardous, but not by how much; the absolute hazard index answers the latter question.

1.2 THE FRA DATA BASES

The FRA has compiled a comprehensive data base containing data on a large number of qualitative and quantitative characteristics of all public roadway-railway grade crossings and all private grade crossings in the United States. This crossing inventory is briefly described in Appendix F (see also Section 3), and is also the subject of an earlier report (Reference 4). It contains, in quantified fixed-format records, information on a great many factors, of which total average daily vehicle volume, total average daily train volume, and maximum warning device class are just three (derived) quantities. There are other quantities related to vehicle volume, train volume, and crossing warning equipment included, and many quantities not related to these, such as estimates of typical train speeds, functional class of road, type of development of the area, etc. In the work reported on here, only those records which refer to public grade crossings are used (219,162 in number). This data base is referred to as "the crossing inventory."

In addition, the FRA has been keeping a complete file on the grade crossing accidents which occur at these crossings; this data base is described briefly in Appendix F (see also Section 3), and also reported on in Reference 3. For the year 1975, a total of 8,028 accidents are represented. This data base (1975 only) will be called the "accident file." The accident file (since 1975 inclusive) is keyed to the crossing inventory by a crossing identification number, uniquely associated with each crossing. This number is included in the record associated with that crossing in the crossing inventory, and included in the record(s) for all accidents which occurred at that crossing. (A certain number of accidents are not linked to crossings because of technical difficulties. See Subsection 2.3.1.)

1.3 PROJECT OBJECTIVES

The FRA asked TSC to investigate accident prediction using the data bases just referred to in order to construct an efficient hazard index whose overall performance on public crossings in the United States would be as good as possible.

The overall goal of this project was to construct and test hazard indexes with the intent of attaining or estimating the ultimate attainable prediction power. In pursuing this goal, it was endeavored to:

a. Rate hazard indexes (previously proposed or arising in this project) on their ability to predict relative and absolute hazard of accidents.

b. Construct hazard indexes which are better in performance than previously proposed or previously used hazard indexes.

c. Attempt to define the limits of power achievable by accident hazard prediction functions, i.e., hazard indexes.

In all three of these endeavors, available information is confined to that in our data bases. In particular, the hazard indexes which are constructed, compared, etc., are all based on the data items which pertain to each crossing in the crossing inventory. Hazard indexes which are based on data items not included in the crossing inventory (for example, "unobstructed sight distance") cannot be compared, evaluated, or constructed in this manner. The data bases at hand are about the most comprehensive of this type ever gathered; therefore, the results reported here should be representative of overall U.S. experience.

The methodology, as described in the next section, is based on the assessment of the hypothetical performance of candidate hazard indexes if they had been used to predict the accidents which have been observed (as recorded in the accident file).

The key elements are:

1. A good representation of performance quality.
2. A means of assessing the sample variability and the capacity for generalization of our measures.
3. A good means of setting up a family of hazard functions which can easily be optimized with respect to an appropriate criterion.

Although goal c above, "define the limits of power achievable," is not a feasible task in so complex a situation, the results may still be quite helpful in this regard.

Note that the goals and methods all pertain to <u>prediction</u>. There has been no attempt to isolate factors which are causally related to accidents. There is a connection between the two endeavors, but since the efforts here are directed solely at predictive capability, i.e., hazard estimation, the results will not necessarily be readily interpretable from a causal point of view.

In more explicit terms, the hazard indexes are for the purposes of identifying hazardous crossings, but if the form of the hazard index formula suggests the direction and magnitude of the influence of a certain factor, this aspect is incidental, and could be misinterpreted. This and related questions will be dealt with in Section 4.

Grade Crossing Funding Allocation Project

An absolute hazard index will be used in the Grade Crossing Funding Allocation Project (FRA-TSC-RR833) currently underway at TSC. In that project, strategies for allocating funds for warning device class improvements among groups of crossings are being worked out and incorporated into computer programs. The marginal benefit/cost ratios for individual crossings which these strategies are based on are proportional to the expected frequency of accidents at the individual crossings; hence, the need for an absolute hazard index. It is clear that absolute, and not relative, hazard indexes are necessary for input to the funding allocation algorithms. One of the goals of this project was to supply such hazard indexes for the funding allocation project.

1.4 NOTES ON STRUCTURE, CONTENT, AND CONVENTIONS

1.4.1 Definitions and Terms

In this report, several expressions will be used as synonyms for "hazard index": "hazard function," "hazard model," "hazard," "discriminant function," and "probability function." The synonyms will clearly refer to hazard index, but may connote interest in a special aspect in certain contexts.

A list of selected terms used in this report will be found in the front section titled "Glossary." This is to provide emphasis and clarification of key concepts, especially when they are discussed in several sections. A brief definition is given in the glossary, and section references are given to key passages dealing with the item. It is, consequently, suggested that the glossary be read straight through by the interested reader, as it will aid in developing the desired perspective.

1.4.2 Appendixes

The appendixes are an integral part of this report. Nearly all the substantive data are in the appendixes. The appendixes allow results to be found easily for reference at any time. They also allow lengthy parenthetical comments without interrupting the discussion.

1.4.3 Notes on Suggested Order of Reading

Section 3, entitled "Course of Experimentation," is, from a slightly different perspective, an overview of the whole project. Some readers have found this section a helpful introduction as well as a general description of what was done. The separate perspective provided by this section is useful for the purpose of helping to communicate a general review of a complex program.

Section 2 (Methodology) can be read over quickly at first. However, the part regarding empirical operating characteristics and power factors is a prerequisite to understanding the results. The rest of Section 2 may be primarily of interest to someone interested in doing further work in hazard index construction.

Section 4 (Results) contains the primary material on what was discovered about hazard indexes and their performance.

It is suggested that for a first reading of this report the easiest sequence to follow would be: Summary; Section 1, Introduction; Section 3, Course of Experimentation; Sections 2.1 and 2.3; then Section 4 (with all its cross references).

Appendix H treats the problem of hazard indexes based on accident histroy. This important subject is placed in an appendix because the treatment here was a late development in the project, with the empirical results being preliminary; further development is anticipated.

2. METHODOLOGY

This section outlines and discusses, from a practical point of view, the methods used to pursue the three goals listed in Section 1.3. The latter section also provides the key elements involved in the methods adopted. A parallel report on the methods used, including more details and theoretical considerations, is under preparation. This will be referred to as "Comprehensive Methodology Report" (CMR).*

2.1 THE EMPIRICAL OPERATING CHARACTERISTICS (EOC)

The primary tool for the comparison of relative hazard indexes used in this study is the empirical operating characteristic (EOC). This term refers to a set of derived data to be used for comparing the performance of two or more hazard indexes on a given data base. The EOC is a set of data derived from an accident and crossing data base which has been ordered according to some hazard index.

In verbal discussions the power factors are often referred to in contexts where reference would be made to the EOC in a more formal discussion. The power factor is closely related to the EOC, and is easy to motivate and to define; hence its currency in verbal discussions without access to lengthy tables or graphical presentations necessary to communicate the entire EOC. The power factor is defined first.

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*The present report is meant to stand alone regarding support for the conclusions. However, there are a number of innovative techniques used here which are discussed more fully in the CMR. A complete discussion is therefore not warranted here. In addition, the CMR contains many techniques which would be applicable to this overall project if time had permitted and is being prepared as a companion report to this document. The methodology covered is applicable to analysis of accident data of various types and in general situations where predictive discriminant analysis is to be used. The Comprehensive Methodology Report does not contain information specific to grade crossing analysis, which this report contains.

2.1.1 The Power Factor

The power factor (PF) is defined as follows: The 10 percent power factor, also written PF(10%), is the percent of accidents which occur at the 10 percent most hazardous crossings (as determined by the given hazard index) divided by 10%. The same sort of definition holds for the 5 percent power factor PF(5%), etc. Thus, if PF(5%) = 3.0, then 5 percent of the crossings account for 15 percent (3x5% = 15%) of the accidents (when the 5% referred to is the 5 percent most hazardous according to the hazard index in question).

The power factor can be seen as a direct primary measure of the efficacy of a hazard index for relative ranking of crossings. Thus, suppose 10 percent of a certain group of crossings is to be selected for improvement, and assume that one wishes to select the most hazardous crossings for this purpose. Then, if a given hazard index is used, the 10 percent most hazardous crossings will be selected according to that hazard index. The number of accidents that may be expected at these selected crossings in any period of time is proportional to the power factor for the given hazard index. The greater the proportion of the total accidents that would occur at the crossings selected as most hazardous, the more effective is the hazard index as evidenced by the power factor; in fact, for some purposes, the "payoff," or benefit, will be proportional to the number (or proportion) of accidents that would occur at the selected crossings, as these accidents may be partially or totally prevented. Consequently, when the hazard index is to be used for selecting the 10 percent most hazardous crossings, the 10 percent power factor seems to be the most direct measure of its effectiveness. The same would hold for the 20 percent power factor if 20 percent of the crossings were to be selected, etc. The complete set of power factors computed at each percentile of hazard (with percentile of hazard defined as the percent <u>more</u> hazardous, and hence, with small order percentiles indicating higher hazard) will give the same information as the EOC. (EOC is, as has been implied, to be considered a more comprehensive term.)

The EOC contains the power factor and other related information. The power factors and the EOC are always computed on a specified data base containing a certain number of accident crossings and a certain number of inventory crossings. The data base information on which the EOC is computed thus actually comprises two data bases: the "accident" data base, which is a random sampling of accident crossings (repeated as many times as accidents occurred at the crossing in 1975); and the "non-accident" data base, which is a random sampling of all crossings (each repeated only once, whether or not it had an accident). Section 3 and Appendix F provide further descriptions of the primary data bases and subsampled data bases.

Appendix F describes the various sampled data bases used in this project. Subsamples of the total data base were used for two reasons:

a. The total number of crossings compared with the number of accident crossings was so large that no appreciable increase in accuracy could be achieved by using all non-accident crossings versus a fractional subsample.

b. The total number of accidents was small compared with the total number of crossings, and therefore all accidents must be used for the purposes of this analysis. Nevertheless, the number of accidents was sufficient to justify dividing them into two groups such that one could be used for hazard index construction, and the other for validation. All subdata bases were further broken down by warning device class for all model development and testing.

2.1.2 The EOC Described

The EOC refers to a large derived data set. A number of EOCs are given in Appendix C. Based on Table C-1 of Appendix C, the information contained in an EOC is described. The first six columns give EOC information pertaining to a given hazard index (labeled there as the TSC model, but numerous TSC models are represented in various EOCs.) Tables C-2 through C-13 have the same format as that of Table C-1. In this section the format referring to Table C-1 is described; however, the most essential information in Table C-2 is presented graphically in Figure E-9. Thus, the horizontal axis of Figure E-9 corresponds to column 1 of Table C-2, and the vertical axis corresponds to column 4 of Table C-2. Further inspection of Figure E-9 will enable one to understand the EOC. For example, Figure E-9 shows that when 20 percent of the crossings are selected as most hazardous by the TSC model, over 50 percent of the accidents occur at them. The tables show the same information (and other information) more accurately.

Table C-1 will now be considered. The table's first column refers to a given percentage of the "non-accident" crossings. This was a straight sampling from the inventory, and included both accidents and non-accidents. Consequently the first column is labeled "% Crossings." The sixth column (labeled "Hazard Index") gives the value of a relative hazard index for the <u>least</u> hazardous non-accident crossing in the group. Thus, column 1 gives the percentage of the "non-accident" crossings whose hazard index equaled or exceeded the value given in column 6. Similarly, column 4 gives the percentage of accidents whose (crossing) hazard index equals or exceeds the same value. Column 5 gives PF(X%), where X percent is the value in column 1. Thus, column 5 is the ratio of column 4 to column 1. Column 3 gives the actual number of accidents on which the percentage in column 4 is based (column 3 and 4 are proportional) and column 2 indicates the increments in column 3 (first differences). The next five columns give the same EOC information on another hazard index -- the New Hampshire formula (based on the same data base). The rest of the columns give information for comparing the two hazard functions. Moving ahead to the 15th column, entitled "CUMMTCH" for cumulative match, one gets a very important number. It tells how many of the accidents counted in columns 3 and 8 (both labeled "CUM#ACC") are identical, i.e., how many matches there are. Thus, the 128 for the second entry in column 15 means that of the 144 accidents selected by the "TSC model" and the 135 accidents selected by the New Hampshire model, 128 were identical, i.e., included in both groups. (All this refers to crossings selected with the 1 percent most hazardous "non-accident" crossings -- for each model in turn.) The cumulative match is important, as explained in the CMR, because it can be used to construct statistical tests for the significance of the observed difference between the two models.

The next-to-the-last column (column 20) will now be considered. That number is the difference between the percent accidents for the two models, i.e., the difference between column 4 and column 8. The last column (column 21) is for testing the statistical significance of the given observed difference. It is called the "t value," but is properly referred to a normal distribution. Thus, a t value of about 2 means "significant at the 5% level," and a t value of 3 means "significant at the 0.5 percent level." (Of course, a t value of 3.5 or 4 would be extremely significant.)

The key consideration here is that the significance refers to each row in the table separately, and does not apply if the row with the maximum value is selected by searching for it. However, when the t value exceeds 3.5, it is always significant. The reason why TVAL = 3.5 is statistically significant even if it is the largest TVAL at any of the 100 half-percentiles is that the probability of getting a standard normal deviate greater than 3.5 is 0.00033, which is less than 0.05 even when multiplied by 100 (a very conservative requirement).

The formula for the quantity "TVAL" is

$$C_{21} = (C_3 - C_8)/\sqrt{C_3 + C_8 - 2C_{15}}$$

where C_i denotes the value in the ith column (see the CMR for derivation).

The formula for TVAL is derived informally as follows: C_3 (column 3) gives the number of accidents selected by the first formula (TSC), while C_8 gives the number of accidents selected by the second formula (New Hampshire). Now C_{15} gives the overlap. Thus, $C_3' = C_3 - C_{15}$ gives the accidents selected by TSC over and above the common accidents, while $C_8' = C_8 - C_{15}$ gives the same for New Hampshire. The variance in C_3' is approximately C_3', and that in C_8' is approximately C_8' (as Poisson variables). The variance in their difference is the variance of the difference of independent random variables (since the overlap has been subtracted out), and so the variance of $C_3-C_8 = C_3'-C_8'$ can be approximated by $C_3+C_8-2C_{15}$. Thus, the test of significance for the comparison of C_3 and C_8 is based on $C_3-C_8/\sqrt{C_3+C_8-2C_{15}}$.

The other columns (12, 13, 14, 16, 17, 18, and 19) are described as follows:

Column 12: same as column 20

Column 13: same as column 21 TVAL, except that C_{15} is set to 0

Column 14: first differences of column 15

Column 16: column 3 minus column 15

Column 17: column 16 expressed as a percentage of all accidents in the data base (for the particular warning device class)

Column 18, Column 19: similar to columns 16 and 17, but for New Hampshire instead of for TSC.

Note: Columns 12, 13, 14, 16, 17, 18, and 19 will not be referred to further in this report.

Once again attention should be called to the fact that Table C-1 (like the other EOC tables) was computed on a specific sampled data base ("Test Data Base -- Crossbucks" of Table F-5). Certain columns (the key columns), however, are referable to the entire data base of all accidents and all crossings (crossbucks) for 1975. The universal columns (estimates for any sampled data base) are 1, 4, 5, 6, 9, 10, and 11. Thus, from columns 1 and 9 we see that the 15% power factor for the New Hampshire formula is 3.32 in the crossbucks case. This means that if one chooses the 15 percent most hazardous public crossbucks crossings (according to the New Hampshire formula) throughout the United States, one may expect that in a given period of time 49.8 percent of the (crossbucks) accidents will occur at these crossings. In particular, the power factors and the basic EOC information -- percent accidents versus percent crossings as well as the relevant hazard index values -- are referable to the entire 1975 data base.

2.2 HAZARD INDEX CONSTRUCTION

2.2.1 The Linear Regression Approach

With the goal of constructing an "optimal" hazard index, this study is, in many ways, similar to a regression problem of fitting an equation in several "independent" variables to observed past concomitant values of the "dependent" variable, and then using the resultant equation to predict future values of the dependent variable when only the independent variables are known. Such a technique is used, for example, in realty tax assessment to estimate what a house would sell for if it were on the market, based on the cost of similar houses which have been sold recently. (Such systems have been used and are being adopted by communities in various states for determining tax valuation based on "fair market" value).

As used here, the dependent variable, as observed in the past, is the occurrence (or number of occurrences) of an accident in a given time period. The prediction is on the relative likelihood of occurrence of an accident in a future time period. One of the mathematical techniques used is identical in some respects to that used in the tax assessment problem. However, although the technique is in part identical to ordinary linear regression, and therefore permits the use of a standard linear regression package, the dependent variable is related to a "yes-no" situation, i.e., is it or is it not an accident? It is not so widely known that such a technique yields an indicator of the probability of an accident for the given values of independent variables. The theoretical considerations will not be covered here (see the CMR), but it is worth mentioning that the particular way the ordinary regression approach was used is equivalent to the Fisher linear discriminant technique. Specifically, classical linear discriminant functions were generated, and the regression package was used for convenience. The precise form that the regression problem takes is:

$$\hat{Y}_i = \sum_{k=1}^{K} X_{i,k} b_k \quad .$$

minimizing

$$\sum_{i=1}^{N} (\hat{Y}_i - Y_i)^2$$

where $X_{i,k}$ represents the numerical value of the kth variable evaluated for the ith crossing. K is the number of variables considered, and N the number of crossings in the sample. Y takes the value of 0 if there was no accident (in the time considered) at the ith crossing, and it takes the value 1 if there was an accident. The purpose is to determine the b_ks [for the interval (k = 1,K)], which specify the hazard function $\hat{Y}$. $\hat{Y}$ is an estimate of the accident probability at the ith crossing. Since $\hat{Y}$ can be less than zero and greater than one, and is not a very good estimate of the probability (it may be transformed into a much better estimate of the probability), we consider it a relative hazard function, indicating only relative probabilities. As stated previously, it is a classical discriminant function.

2.2.2 Iterated Weighted Logistic Discriminants

Besides the ordinary regression approach to hazard index construction (which, as noted above, is also the Fisher discriminant function approach), other approaches were used. The most important of these techniques, which were used to construct the most valid and useful models, was a particular iterative weighted regression approach. Since it fit a logistic function to the probability of accident, it was called the "logistic discriminant approach." Iterative weighted regression has become the subject of much interest in recent years, but, for the connection to logistic discriminants (as used in this study), the reader is referred to the CMR, as one cannot do justice to the subject here. Logistic discriminants have been available for many years. The classical approach will be found in Cox (Reference 6). However, the approach used here is better described by reference to robust and iterative weighted regression techniques; these considerations are well described in Mosteller and Tukey (Reference 7). The particular approach used here and its justification can, as far as can be determined, be found only in the CMR. The salient features which distinguish it from ordinary logistic discriminant analysis become, in this context:

a. The ability to put the major emphasis on correctly identifying the high hazard crossings.

b. "Robustness" and "resistance" -- technical terms for important qualities in regressions. In this case, the benefit is that the logistic model doesn't have to hold exactly for the estimates of the hazard function to be valid, and also errant data points, i.e., those in strong disagreement with the others on the model parameters, have small effect. (These points are dealt with more completely in the CMR.) The version of logistic discriminant analysis used here is especially suited to this problem.

What then is logistic discriminant analysis? It has been noted in the statistical literature that the logistic function is a good model for the probability of an event when expressed as a function of a number of variables in a fairly wide variety of cases. Such an argument is often preferred by some statisticians, even when it is very unlikely that the "wide variety of cases" covers the case at hand. The simple fact remains that the logistic function, or logit function, has some useful properties. Logistic discriminant functions are discriminant functions, i.e., hazard indexes, which are logistic functions of linear combinations of the independent variables. The logistic function is simply:

$$H(h) = \frac{1}{2} + \frac{1}{2}\tanh(h) = \frac{1}{1 + e^{-2h}}$$

Logistic discrimination is the seeking of coefficients b_k such that:

$$h_i = \sum_k b_k X_{i,k}$$

where $X_{i,k}$ is, as in ordinary regression, the kth characteristic of the ith crossing. The coefficients are to be chosen such that H(h) is a good absolute hazard index, i.e., $H(h_i)$ accurately estimates the probability of accident for the ith crossing. If the probability of accident is considerably less than 1, the probability of accident is equal to the expected number of accidents during the same time period.

Since H(h) is a good absolute hazard function and H is a strictly increasing function, this means that h is a good relative hazard function. The statement "h is a good relative hazard function" ("hazard function" is synonymous with "hazard index") means that if $h_i > h_j$, then crossing i has greater accident hazard than crossing j, or the expected number of accidents is higher at crossing i than at crossing j, or the probability of an accident is higher at crossing i than at crossing j.

It is important to note that to get a good relative hazard index it is necessary to construct a good absolute hazard index, i.e., predicted accident frequency. This fact leads to the use of the logistic discriminant analysis, since the logistic function has properties which make it a suitable foundation for an absolute hazard function. The chief properties which make it a reasonable function to "shape" a linear hazard index into a function which gives probability of accident are:

a. It is strictly increasing.

b. It does not go below zero or above one.

c. In the "tails," i.e., for very large or very small values of the hazard index, it approaches its limit (either 0 or 1) exponentially.

The actual construction of a logistic discriminant type hazard function or hazard index is described in Appendix A.

2.2.3 Hazard Function Development and Variable Selection by Synthesis of Regression and EOC Techniques

The basic principles used in hazard function development and variable selection are about the same, whether the development is based on an ordinary linear regression or on the iterative weighted version described in subsection 2.2.2 and Appendix A. The procedure for the ordinary linear regression case is considered first. Figure 2-1 will assist the reader in following the discussion below; however, it must be kept in mind that the figure describes the process using the logistic approach and not straight linear regression, which will be described first. The full process, including the logistic approach, will be outlined immediately after that.

2.2.3.1 Linear Case -- The fundamental unit of search or research is a stepwise regression followed by an empirical operating characteristic (or power factor) calculation. A "variable pool" of from 2 to about 35 raw and derived variables is supplied to the stepwise regression. This is a set of characteristics or variables as quantified in the crossing inventory and perhaps transformed by some function. For example, log C and log T have been previously mentioned as possible variables. (Recall C = AADT = average daily vehicle volume, and T = average daily train volume.) "Is the highway paved?" yields a variable which is 0 for unpaved, 1 for paved. "Population" is another variable (see Appendixes B and D for definition), as is "functional class of road," and "number of highway lines," "number of main tracks," "number of switch trains," etc. Derived variables include log C, log T, log C x log T, "highway paved" (0,1) times "nearby intersecting highway" (0,1). The last variable is determined by the product of a variable which is 0 or 1 depending on whether the highway is paved, times another variable which is 0 or 1 depending on whether there is a nearby intersecting highway. If 1 represents "yes" in both cases, the result will be 0 in all cases except the one in which both the highway _is_ paved and there _is_ a nearby intersecting highway. Clearly, an infinite number of derived variables can be generated. The

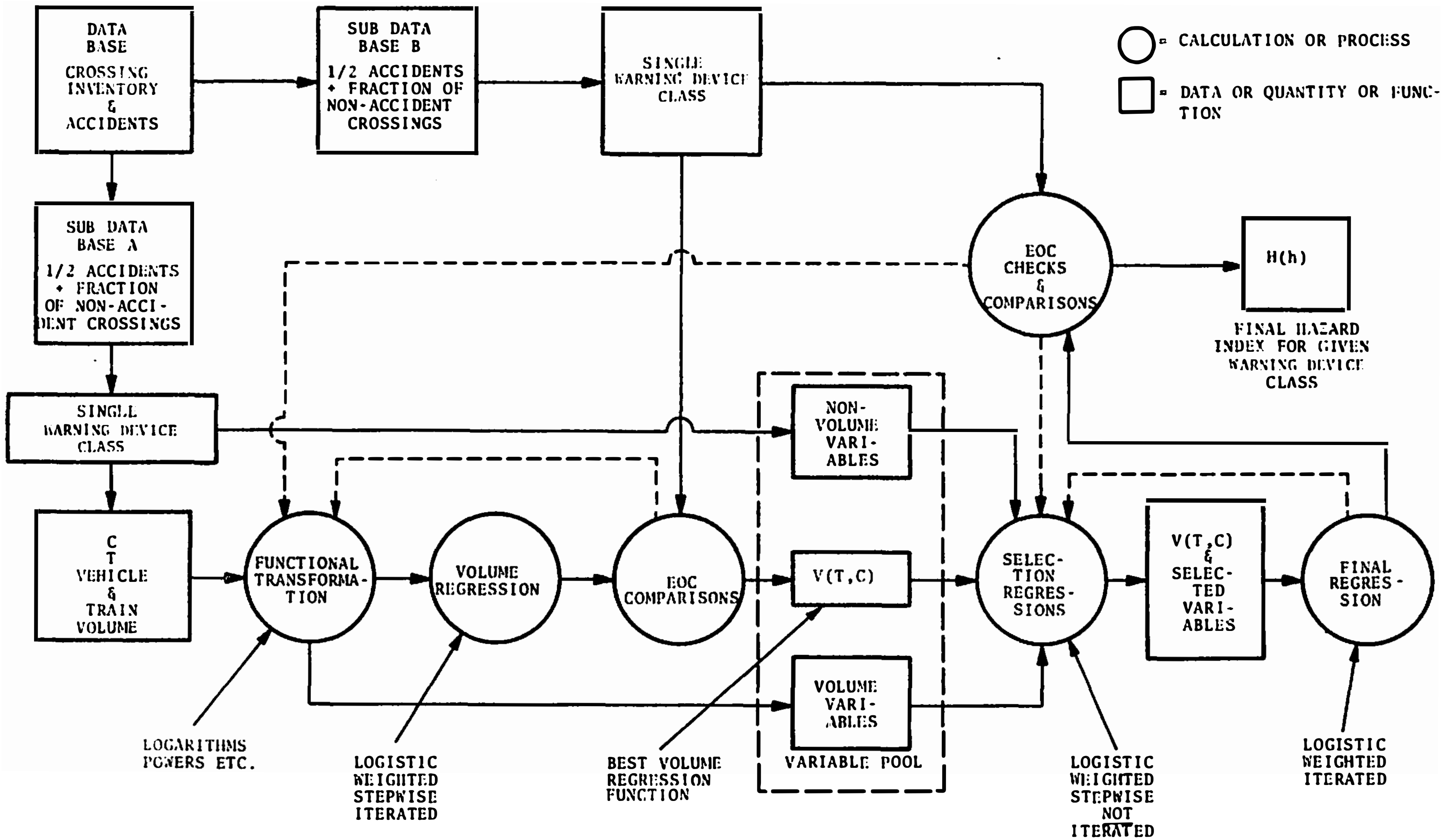

FIGURE 2-1. HAZARD FUNCTION CONSTRUCTION - LOGISTIC DISCRIMINANT & EOC APPROACH

variables which can be generated from functions of C (average daily vehicular traffic) and T (average daily train traffic) are what are called volume variables. Thus, C, T, log C, log T, and log C • log T, etc., are all volume variables. As is noted below, volume variables were found to be the chief determinants of hazard functions. Thus, it might be hoped that simple functions of the other variables would be sufficient when combined with optimal volume functions. Basically, if a non-volume variable were needed in the hazard index, the raw form should suffice when an optimal volume function was already contained in the regression. Thus, the stepwise regressions were primarily of two types.

1. A regression containing different volume functions in order to find an optimum volume function.
2. A regression in which a "pre-optimized" (volume only) function was included in the variable pool as well as non-volume variables (volume variables were also included to test the optimality of the volume only function).

A stepwise regression selects the variables one at a time from the variable pool according to how much each variable adds to the "goodness of fit" of the regression to that point. Therefore, the stepwise regression was run for several steps, adding more and more variables into the regression. Later, the results were examined to see at which steps the variables entering the regression made a "significant" contribution according to their "t values." The t values, as printed out by the regression package, are not directly interpretable in terms of prediction capability. Therefore, an empirical operating characteristic (EOC) had to be calculated for selected steps of the stepwise regression. For example, after running 15 steps of a stepwise regression (after which 15 variables had been included into the regression), an EOC might be run for each of steps 8, 9, 10, 11, and 12, since after step 12 the t values indicated that the regression was not being contributed to significantly.

If the t value indicates no significant contribution to the regression, for example $t < 3$, then it may safely be assumed that the further variables will add nothing to the accident prediction capability, since the t values are based on the regression criterion (i.e., least squares). If the t values are small, the regression isn't being helped (in terms of minimizing the square error) and since the regression criterion isn't being helped, its use in another connection (accident prediction) won't be helped either. However, the converse is not, in general, true: a variable can contribute significantly to the regression, i.e., to lower the sum of the squares of the residuals, without contributing to the predictive power of the resulting hazard index. For a measure of the latter feature the EOC is needed. Thus, from the EOCs at a number of steps, the best step is selected, and the result is a hazard function for further analysis, comparison, or even for use in further constructions. Thus, for either volume or non-volume (comprehensive) regressions, the regression must be followed by one or more EOCs (power factor table or plot).

In using EOCs for model development, the EOCs for selected steps in a regression or for the best steps from a number of regressions are compared. The criterion is the number of accidents included in the highest hazard groups, which include 5 percent to 25 percent of the non-accident crossings. In other words, the 5%, 5.5%, 6% ... 24%, 24.5%, 25% power factors are compared (PF1 or PF2). If two hazard functions from two different steps of one regression or from two different regressions intertwine their EOCs, i.e., if they alternate several times in which one has the higher power factor over this whole range of 5% to 25%, then they may be considered roughly equivalent. But if one has higher power factors for most or all this range (and substantially higher at some points), then that one is to be considered tentatively identified as a superior hazard function. Notice that in general the regression statistics are not sufficient to make this distinction. In other words, the t values, multiple correlation coefficients, and F values do not point to the better hazard function except in a general way. In a gross manner they do -- otherwise, regression, and especially stepwise regression, would be useless -- but the regression statistics do not reliably tell the whole comparison story. If, of two regressions, one has a much better multiple correlation coefficient than another, then the one with the higher correlation coefficient will probably have the better hazard function, but only the EOCs can enable one to make the final decision.

The result of this is that many regressions must be run and their EOCs checked at a number of steps. Since the EOCs are more time-consuming and costly to produce than regressions, this leads to a more costly and time-consuming process than if all information were contained in the regression statistics.

Of the various ways of ensuring external validity of the models (hazard functions) produced, one of the simplest has been chosen. Two separate data bases have been developed disjoint and created under statistically identical conditions. This was done by dividing the accident crossing set into two equal parts and adjoining a separate fractional sample of the non-accident crossings* to each. The details are described in Appendix F. Although this was done in different ways at different stages of study, the discussion is simplified by referring to the two separate data bases as data base A and data base B which were separate, disjoint, independent, but identically created from a statistical point of view. The idea is to create hazard functions on one data base, and test or validate them on the other. The original plan was to do both regression and initial selection on one data base and final selection on the other. But since the EOCs are costly to run, it became apparent that the testing had to be speeded up; the eventual procedure, then, was to run all regressions on one data base (for example, data base A) and all EOCs on the other data base (data base B). Thus, every power factor is, in effect, a "validation." This weakens the ultimate validation of the models used here, because some of the selection process was carried out

*A random crossing from the crossing data base is consistently referred to as a "non-accident crossing." Whether or not it experienced an accident is not determined. See also Section 3.

on the "validation data base." The amount of weakening is, however, far less than if the regressions were also done on that data base. Since the data bases are quite large, the weakening should be slight. If time permits, the crucial steps of final regression and testing should be repeated, reversing the roles of the two data bases.

2.2.3.2 Logistic Case -- The procedures of stepwise regression alternated with EOCs (power factor tables or plots) when ordinary linear regression is used has been described above. When iterated weighted regression, i.e., logistic discriminant function construction, is used, the procedure is very similar except the stepwise regressions must be iterated several times. With reference again to Figure 2-1, the whole process is discussed with the logistic, iterative regressions used. Figure 2-1 represents something of a simplification, because the process is not quite so formal as depicted there. The steps there were carried out many times, and much effort was spent in trying to find better functions and combinations. This is indicated to a degree by the dotted flow arrows. As this process is now discussed, Figure 2-1 should be referred to frequently.

Typically, a certain small group of volume variables -- e.g., $\log(T+1)$, $\log(C+1)$, $\log(C+1) X \log(T+1)$, $[\log(C+1)]^2$, $[\log(T+1)]^2$, see Section 3 for details -- is run through a complete iterated regression. Any terms with small t values are dropped, and the iteration continued until convergence is achieved. The resultant hazard function has an EOC run on it, and its performance as compared to the New Hampshire formula is tested. (One warning device class is worked on at a time, i.e., the whole procedure, as described in this section, is done separately on each warning device class and repeated three times for three warning device classes.)

At that point, it is determined whether any of the other simple volume terms used will enter a stepwise weighted regression with significant values. It is important to note several key points:

a. The hazard function at this point could be called 90-95 percent complete in terms of its performance.

b. Because of point (a), the t values for small groups (1,2, etc.) of variables which were then entered into the "selection" regression (with the primary volume hazard function as one variable) were indications of the true t values of these variables.

The use of t values to guide the choice of new variables for the regression (which is how stepwise regression works) is problematic in ordinary linear regression, and even more so in the iterative weighted (non-linear) case, since the t values are not even correct estimates of the uncertainty in the coefficients any more. However, as just noted, they are somewhat indicative of the precision and statistical significance of the corresponding coefficients b_k. They will, in general, be overestimates of the true t values, i.e., the t values as output by the linear regression routine will in general overestimate the true t value which would be obtained if the estimated coefficient were divided by a good estimate of its standard error. Using more sophisticated methods (cf "jacknifing," Reference 7), one can calculate an estimate of the true covariance matrix, and thus, the true standard errors of the b_ks (regression coefficients) can be calculated in the iterated case. This step has been bypassed in order to focus the available time and resources on a wide exploration of regression equations and tests of these equations. The assumption is that the "linear" t values can serve as a crude guide, letting the EOC be the final arbiter of which variables add to the predictive power of the hazard function.

In contradistinction to the above less-than-wished-for state of affairs, it should be noted that what are called "selection regressions" are run with a nearly optimal hazard index determining the weights. Furthermore, they are run only once, and are thus "semi-linearized." It is possible to run such a regression that the regression statistics (t values, etc.) are essentially true conditional (intermediate) values. Since the selection regression is used to select variables, it can be run in the stepwise mode, and the near validity of t values and other regression statistics is especially fortunate. The point is that the t values in the selection regressions have very close to true validity (conditioned on the volume hazard index), and this is just the sort of thing desired for the selection regression.

As has been noted, a "best volume function" is found first using the iterative procedure described above. An additional iteration can be run using the resulting h in a polynomial. This step will be described in Section 3. When the volume function has been improved, a new weighted stepwise regression is run in which non-volume terms are allowed to enter (selection regression). Some volume terms are included in the variable pool, so that if the volume function is not completely optimized, they will be picked up early. They may be picked up at later steps to compensate or adjust for the effects of non-volume variables which have already entered. Each of the non-volume variables used is based on a single variable in the crossing inventory. Since the volume part of the function is so important, it was felt that non-volume terms, which add little to the function, could be expected to make their contribution as single variables, i.e., no cross products. Sections 3 and 4 show the justification for this.

The stepwise regression selects non-volume variables from a large variable pool. They are selected, of course, by the t values. These t values may be expected to be rough to good indications of which variables to select as indicated above. The key to the procedure is that the stepwise procedure is cut off at a very high t value, and the variables selected at that step are then to be used in a final iterative regression. The stepwise regression just described is of the weighted type with U(h) and V(h) (see Appendix A) determined by the h for the best volume regression called V(C,T). From this point, the final iterations use the volume function V(C,T) as one of the variables along with the non-volume variables (and any additional volume variables) selected in the stepwise selection regression just run.

Several sets of variables, as chosen at different steps of the selection regression, are run through the iterated regression. Each is run through several steps until convergence of a comprehensive (volume and non-volume) hazard index is achieved. EOCs are run on each, and the best is selected as the final hazard index for the given warning device class.

2.3 EXPECTED ACCIDENT FREQUENCY (ABSOLUTE HAZARD INDEXES)

2.3.1 Expected Accident Frequency from Logistic Discriminants (TSC) Nonlinear Hazard Indexes

As noted earlier, the primary interest in comparing hazard indexes is to determine their relative ability to select hazardous crossings -- that is, to compare them as relative hazard indexes. Once a good relative hazard index is determined, it can be converted to an absolute hazard index. Presently it will be shown how to get an absolute hazard index from the analytic expression for the power factor curve. In addition, the logistic discriminant procedure produces hazard indexes which are immediately interpretable as absolute hazard indexes. This is because $H(h) = 1/1+e^{-2h}$ gives the probability of the crossing being an accident crossing. (One needs to recall that h is any of the HIs of paragraph B.5 of Appendix B. It is a relative hazard index. The value 10,000h is the value indicated by the numbers in column 6 of Tables C1-C6, the HAZARD INDEX column for the TSC model.) Because the "non-accident data" base was really a straight sample of the inventory, and since the "accident crossings" file had each crossing repeated for each accident occurring at the crossing (proportional representation) this results in the estimate of the frequency of accidents per year at a crossing as:

$$\frac{C_1 H}{1-H} \text{ or } C_1 e^{2h}$$

The quantity $h \times 10^4$ is the quantity tabulated under "TSC MODEL-HAZARD INDEX" in Table C-1, etc. The constant C_1 is dependent on how many accident crossings (accidents) and how many crossings were selected for the sub data base versus the same ratio in the total data base. If, for the given warning device class, there were M total accidents (in the 1975 accident file) and N total crossings while in the sub data base used for creating the hazard index, there were m total "accident crossings" and n total sample from the inventory i.e., "non-accident crossings," then:

$$C_1 = \frac{M}{N} \frac{n}{m} r.$$

The quantity r is a scale factor which takes into account that not all accidents occurring at public grade crossings in 1975 were represented in the accident data base used here. The reason for this lack of total representation is that some of the accident records could not be linked to the crossing records because of missing or invalid crossing i.d. information. With 8,028 accidents represented in the data base, and with a total of 11,350 accidents at all public grade crossings in 1975, one can scale C_1 by the factor r = 11,350/8,028 to arrive at a final scale factor for converting e^{2h}TSC into expected accident frequency in 1975. Table 2-1 gives the values of M, N, m, n, and C_1 for each warning device class considered.

TABLE 2-1. FACTORS FOR ABSOLUTE EXPECTED ACCIDENT FREQUENCY

Warning Device Class	M	N	m	n	r	C_1
Crossbucks	3,969	141,477	1,985	20,188	1.414	0.403
Flashing Lights	2,650	33,969	1,326	13,250	1.414	1.10
Automatic Gates	707	11,983	354	3,535	1.414	0.833

Thus, hazard index h gives rise to the absolute hazard index C_1e^{2h} as an estimate of the expected yearly accident frequency at the crossing. The statistical measures of goodness of a probability estimate are not always enlightening, and so one seeks to construct a direct (if crude) estimate of this probability function against which to check the hazard index. One such estimate is to base it on the relative numbers of incremental accidents in each 1-percent interval. Figures E-2, etc., show plots of frequency of accident, $f(h) = C_1 e^{2h}$, versus the above crude empirical estimate for the TSC comprehensive models for crossbucks, flashing lights, and gates. The scatter of the empirical estimates is to be expected, and does not reflect a fluctuation of the true value. The true value should cut through the center of the scatter, and so a rather good fit is observed. Section 4.3 will discuss these plots in detail.

2.3.2 Absolute Hazard Indexes Based on Power Factor Information

It has been noted that the EOC and power factor information is useful for comparing hazard indexes on a relative basis, i.e., to assess their efficiency in ranking crossings for relative hazard. Every absolute hazard index is a relative hazard index, and so absolute and relative hazard indexes can be compared with each other, all on a relative basis. In this section the new hazard index construction techniques employed have been discussed, and the ultimate techniques result in absolute hazard indexes (the TSC models yield an estimate of expected accident frequency per year) at each crossing. Section 4.3 exhibits the results of such estimates, and gives an indication of how accurate they are.

It is a property of most hazard indexes previously given in the literature that they are poor estimators of absolute hazard, although they may not be poor estimators of relative hazard. (Some of the Coleman-Stewart models are possibly exceptions. See Section 4.3.) Therefore, a technique for deriving absolute hazard indexes from relative ones has been developed. As noted above, the new hazard index construction technique used in this project yields <u>directly</u> an absolute hazard index. Consequently, the method given in this subsection is primarily to convert <u>other relative</u> hazard indexes into absolute hazard indexes.

If the power factor as a function of percentage of crossings is denoted by $\rho(\lambda)$, where λ is expressed as a fraction rather than as a percent, i.e., λ = percent crossings more hazardous/100%, and $\rho(\lambda)$ is the power factor at that percent (or fraction), then an analytic expression may sometimes be found which approximates this relation. Thus (see Section 4), to some degree of approximation, $\log \rho = \alpha(\log \lambda)^{\beta}$ (where α and β are constants) can be used to represent the power factor function. The key fact is that if an analytic representation for $\rho(\lambda)$ can be found, then, whatever the form, an expression for the expected accident frequency, f, can be found. One needs to remember that the expected accident frequency (number per year) f is what is called an absolute hazard index. If $\rho(\lambda)$ is the power factor as a function of proportion of most hazardous crossings, then:

$$f = C_2\, \rho\left(1 + \frac{d \log \rho}{d \log \lambda}\right) = C_2\, \rho\left(1 + \frac{\log \rho}{\log \lambda} \frac{d \log \log \rho}{d \log \log \lambda}\right)$$

$$C_2 = \frac{M}{N} r$$

where,

M = total number of accidents in data base which ρ represents

N = total number of crossings in the data base

r = scale factor (see Section 2.3.1 and Table 2-1).

This expression is exact and will give an exact absolute hazard index f unless the expression $\rho(\lambda)$ does not adequately express the relation of power factor to percent (proportion) of crossings. If $\log \rho \approx \alpha(\log \lambda)^{\beta}$, then $d \log \log \rho / d \log \log \lambda \approx \beta$, and so

$$f \approx C_2\, \rho[1 + (\log \rho/\log \lambda)\, \beta]. \qquad **$$

Section 4 shows that an expression of this form (with β constant) for f gives satisfactory estimates of accident frequency (absolute hazard index) in cases of interest.

The expression $\Delta \log \log \rho / \Delta \log \log \lambda$ can be evaluated over short ranges in the EOC table, so that, in effect, β is not a constant. This possibility is mentioned for later analysis, since, although the behavior of $\Delta \log \log \rho / \Delta \log \log \lambda$ for 1/2-percent intervals for one data base is exhibited (see Table C-7), the form (**) with β constant is adequate for the present purposes.

(Note: Up to this point the methodology has been explained; for the results, refer to Section 4.)

The use of the expression (**) to determine f requires an EOC table in which f can be calculated as a function of raw (relative) hazard index. As has been noted, for each 1/2 percent increment in crossings the hazard index (New Hampshire) h has been tabulated (in Table C-1 and other tables of that format) in column 11; in column 10 the power factor, ρ; and in column 1 the (cumulative) percentage of more hazardous crossings, λ X 100. Thus, for a given value of h (New Hampshire), h is first located in column 11, then the corresponding value of ρ has to be found from column 10 and λ from column 1 (dividing the latter by 100), and this substituted in expression ** to determine f(h). (See Table 2-2.)

This procedure need not be carried out if one of the new hazard indexes (produced in this report) is used, as they directly yield a value for f. However, the technique is valid for converting relative hazard indexes of any sort to absolute hazard indexes.

TABLE 2-2. EMPIRICAL POWER FACTOR FORMULA FOR THE NEW HAMPSHIRE MODEL

$$\rho \approx \alpha(\log \lambda)^{\beta} \leftrightarrow f \approx \frac{M}{N}\, r \left(1 + \frac{\log \rho}{\log \lambda}\, \beta\right) \cdot \rho$$

for the New Hampshire formula:

	β	M/N	α
Crossbucks	.7 ± .1	.028	.76
Flashing Lights	.75 ± .1	.078	.65
Gates	.6 ± .1	.059	.62

Thus, for λ = .005 (.5%) to λ = .5 (.50%)

$$\beta = \frac{\Delta \log \log \rho}{\Delta \log \log \lambda} \qquad \alpha = \frac{\log \rho}{(\log \lambda)^{\beta}} \qquad r = 1.41$$

log = natural logarithm (log 2.71828 = 1).

Information for calculating best α and β values for all cases in EOC Tables C-1 to C-7. (See Sections 4.1.1, 4.1.2 and 4.1.3.)

Note: The second term $[(\log \rho/\log \lambda)\cdot\beta]$ within parentheses in the above equation for f is to be considered negative.

3. COURSE OF EXPERIMENTATION

Over the years, several models have been developed with the purpose of creating a relative ranking of accident potential (hazard index) attributed to railroad crossings. Many of the models were constructed using local (and in some cases specialized) data, and were not representative of other areas of the country. Moreover, the small amounts of data used to construct the models challenges the accuracy of the results.

The creation of the inventory data base meant that, for the first time, large amounts of standardized inventory data were available for the construction of an accident prediction model. Table F-1 of Appendix F describes the format of the inventory data base.

The data available for this study were molded into two forms:

1. The inventory characteristics of all public railroad crossings (219,162 crossings).
2. The inventory characteristics of public railroad crossings which had an accident in 1975 (8,028 crossings, with 943 duplications for multiple accidents).

These two sets of data became known as the "non-accident" data base (inventory characteristics of railroad crossings) and the "accident" data base (inventory characteristics of railroad crossings which had an accident in 1975).

The "non-accident" data base contained each crossing whether or not it had an accident and each crossing occurred in the "accident" data base as many times as it had accidents. As a result, there was a certain amount of overlap (redundancy) between the two data bases as well as within the accident data base. Since the accident base consists of the inventory characteristics of the public crossings which had accidents in 1975, and the non-accident data base consists of the inventory characteristics of all public crossings as of 1975, by definition the characteristics of all crossings with accidents are contained in both data bases. This precipitates an overlap of 3.66 percent. Furthermore, on investigation of the crossing identification numbers for the accident data base, 943 crossings out of 8,028 were found to have multi-accidents. Table F-4 of Appendix F contains a breakdown of these multi-accident crossings.

It should be pointed out here that the non-accident and accident data bases were the complete sets of data available. Variable subsets of data were extracted from both data bases to provide input for the particular mathematical tool being implemented. Subsets were used because of the economics of time and money which could be saved instead of using the complete sets of data.

In most cases, these subsets consisted of two pairs of accident/non-accident data bases; one pair was used for developing a model, and the other pair for validating the model developed. These pairs were, for the most part, statistically and numerically identical while, at the same time, disjoint. Table F-5 provides the breakdown of the non-accident and accident data bases by warning device class. (Table F-5 refers to the data bases used for the nonlinear logistic case only. All results reported on in Section 4 are for this case.)

As a starting point for the construction of an accident prediction model, both data bases were reduced. These data originally contained 84 fields of information, but for the purpose of this study, only 51 fields were extracted (see Table F-2). Some fields were eliminated because they were descriptive in nature and hard to quantify.

The 51 fields describing railroad crossing inventory characteristics were examined. One particular report (Reference 8) was very useful in providing areas of concentrated and isolated inventory characteristics.

After familiarization with the data available and extracting only the fields of interest, several existing models which provide a hazard index were examined. The purpose of this examination was two-fold in nature. First, by examining inventory characteristics used in previous models, insight was gained in finding those characteristics which seemed to be more predictable. Secondly, it was intended to use these previous models as benchmarks to which the newly constructed models might be compared.

Of these models examined, only three were found to be applicable to the data bases: the New Hampshire formula, the Peabody-Dimmick formula, and several formulas calculated by Coleman and Stewart. These equations appear in Appendix B. The remaining models were deemed unusable, because their formula called for variables not included in the operating data bases. Some of the variables were accident experience (or accident probability) and a sight distance rating. (Note that accident history may and should be used in further studies with the FRA data bases.)

By use of a linear regression technique (the first technique that was tried), variables (inventory characteristics) were examined further to determine their relative rank of predictability for accidents. Several observations were noted at this point. They will be discussed later.

From previous studies it was decided that the best approach to constructing an accident prediction model hinged upon the segregation of the data by warning device class (see Table F-3). Because they contained the largest amounts of data, crossbucks were examined first. This particular theme of examining only those crossings with crossbucks was carried throughout the model building until an adequate crossbucks model was obtained. At that point the other warning device classes were examined separately.

From the total reserves of data, 15,654 "non-accident" crossings (actually without regard to whether or not accident occurred, and which were selected randomly) and 1,246 accident crossings, all of which had crossbucks, were extracted for testing purposes. A linear regression was to be used. Later it was shown that a nonlinear regression worked better.

First to be described here is some extensive experimentation with linear regression because of some basic principles brought out in the course of that work. However, the chief results reported in Section 4 came from the nonlinear regressions which are also reported on in this section.

The linear regression was constructed as follows. There were 27 independent variables and one dependent variable. The dependent variable was either a zero (0) for the crossings from the non-accident subset, or a one (1) for those crossings from the accident subset. Theoretically, each dependent variable approximated the probability for an accident at each crossing. Thus, the crossings that had an accident were given a probability of 1, while those crossings that did not have an accident were given a probability of 0. The values for the independent variables were the inventory characteristics themselves as they appeared in the subsets. No distinction between accident and non-accident data was made for the independent variables. The results of this regression appear in Table D-1 of Appendix D.

The conclusion drawn from this initial examination was simplistic: volume variables (train and vehicle movements) contributed more to the predictability of the regression than did the non-volume variables. This conclusion is drawn from two pieces of evidence. First, the correlation matrix indicates that the volume variables consistently have higher coefficients (when crossed with the dependent variable) than the non-volume variables. Second, three of the first four terms selected by the regression were volume terms.

It was decided that the best approach to understanding the volume variables was to construct and run regressions which contained only volume terms. In order to meet this end, many regressions were run which contained many varied functional forms of all volume variables plus combinations of volume variables. Those variables and functional forms which showed promise were sifted out for further examination and optimization.

One of the problems faced was the determination of which regression model was the better predictor. Not only were there numerous regressions to choose from, but each regression had many steps (a stepwise regression model was utilized) in which a model could be constructed. There were well over 100 possible models from which to choose.

Power factors and "empirical operating characteristic" (EOC) curves* were utilized to determine the best models. After each regression was run, power factors were computed for several different steps of that regression. These power factors could then be examined to determine the "best step" for that regression. Each "best step" for a regression could then be compared with other "best steps" from other regressions to find the optimal model.

During these proceedings, several trends were observed. First, in any given regression, colinearity usually destroyed the power factors when 10 or more variables composed the model. This manifested itself in the regression through low t and F values, and in many cases, the signs of the regression coefficients were reversed. Second, the LOG_{10} functional form was a better predictor than other functional forms.

With these discoveries in mind, a final regression was constructed to obtain an "optimum volume model" The independent variables for this regression are shown in Table D-2 of Appendix D. As usual, the dependent variable was 0 or 1. Several steps of this regression were compared against each other using power factors. The "optimum volume model" was derived from step 5. This formula appears in Appendix B.4.1.

Having obtained the best volume model, the next logical step was to piggyback non-volume variables onto the volume model. To obtain this effect, the volume model was made an independent variable and fed into the pool of independent variables along with non-volume variables and combinations of non-volume variables and volume variables.

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*The terms "power factor" and EOC are defined in the Glossary and Index of Selected Terms and Expressions and also in Section 2.1. The power factors and EOCs are the primary measures of predictive power used throughout the study. They were calculated on separate data bases from those on which the regressions were run.

The purpose of inserting additional volume variables as possible selections for a comprehensive regression is twofold. First, it serves as a check on the volume equation to insure that various volume data are best represented, and secondly, combining them with non-volume variables enables the possibility of several cross-product variables being selected which would not have been chosen by themselves.

Several regressions were processed using this approach. Two examples of these comprehensive linear regressions are shown in Tables D-3 and D-4 of Appendix D. Again, several steps from each regression were compared; power factors were used to determine the "best step" for each regression, and "best steps" from all the regressions were compared to determine the "best model." From the many steps and regressions examined, two models were selected as the "best models." These appear in paragraphs B.4.2 and B.4.3 of Appendix B. (They are referred to as "best linear models." The best nonlinear models, to be discussed shortly, were better.)

The power factors and EOCs showed these "best" linear models to be superior to the New Hampshire and Coleman-Stewart models. However, the data base for testing the models was inadvertently not disjoint from the data base for constructing them. When this was discovered, some preliminary testing indicated that the improvement was not statistically significant. Much later, a special experiment was run to compare the best linear models with the best nonlinear (logistic) models developed in this project. This experiment is reported in Appendix G.

The construction of a comprehensive "best model" (linear) concluded the work in which a linear regression technique was used. The observations from this segment are summarized below.

1. Volume variables (train and vehicle movements) account for approximately 90 percent of the predictive powers of the regression.
2. Regressions with more than eight variables frequently produced poor power factors due to colinearity. The signs of colinearity included low t values, low F values,

misdirected signs of variables, and high cross-correlation coefficients as seen in the correlation matrix.

3. The New Hampshire formula and the Coleman-Stewart formula (for urban/rural crossbucks) were similar to each other in that they produced almost equivalent power factors. Furthermore, the ranking capabilities of both these models were good. In contrast, the Peabody-Dimmick formula was inferior to both the New Hampshire and Coleman-Stewart formulas.

4. The best TSC model was at least as good as both the New Hampshire and Coleman-Stewart formulas.

5. The best TSC model appeared to be not quite statistically significantly better than the New Hampshire and Coleman-Stewart models.

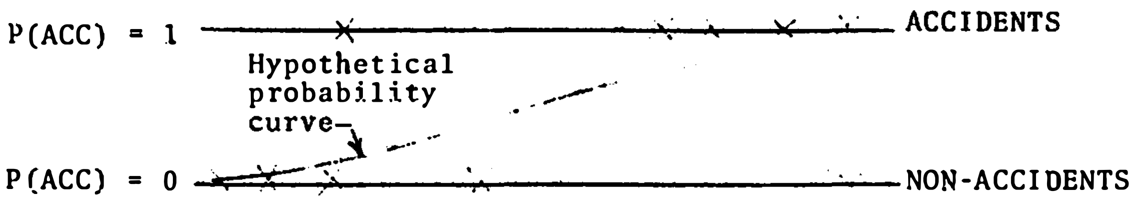
6. Linear regression techniques might not be providing an adequate tool for producing optimal or near optimal models. Many regressions containing hundreds of different combinations and functional forms were tested, evaluated, and validated, yet none appeared to significantly improve the ranking capabilities over either the New Hampshire formula or the Colemen-Stewart formula.

Because of the less than satisfactory results using linear regressions techniques, other approaches were tried. The next approach required the calculation of cross-tabulation tables for both the non-accident and accident data bases.

Having obtained the cross-tabs ratios (ratios of the number of accidents in a particular cell to the number of non-accidents in the corresponding cell), these ratios were used in conjunction with a stepwise linear regression to construct an accident prediction model. Several regressions were run using various functional forms of these cross-tabs ratios. It soon became apparent that many regressions which could introduce various functional forms and combinations were necessary to obtain a significant model. Since the approach was time-consuming compared to other approaches, it was abandoned before any conclusive results could be found.

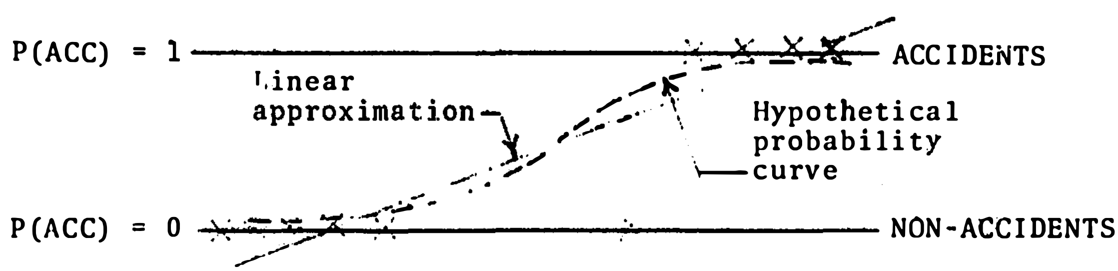
At this point a different approach was tried. The following serves as a simplistic explanation of the problem to be solved and the new directions available.

If one were to represent the accident and non-accident data as probabilities, the point and line curve would look like the sketch below.



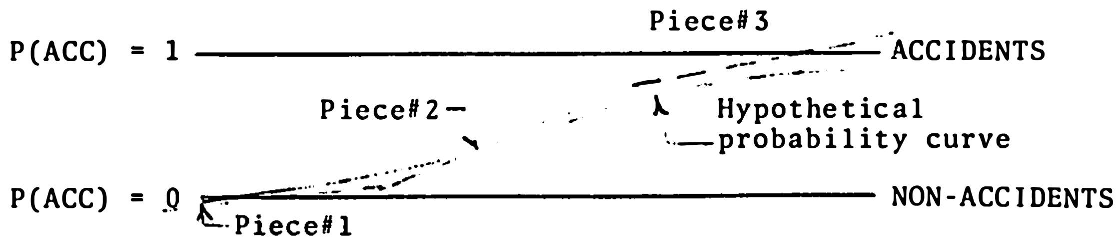
If the data are from an accident crossing, its probability for an accident is 1; thus, the points along P(ACC) = 1. If the data are from a non-accident crossing, its probability for an accident is 0; thus, the points along P(ACC) = 0.

If one were to fit these points using a linear regression model, the approximation would be a straight line as shown below. Note that this approximation is weak where P(ACC) = 0 and P(ACC) = 1, the places where good fits are necessary.



Not only is the linear approximation a crude fit, but it also produces an overshoot where P(ACC) = 1, and an undershoot where P(ACC) = 0. This appears to be a satisfactory explanation of the linear regression not being able to produce a significant accident prediction model.

Another approach to the problem considered the use of piece-wise linear fits. The theory behind this approach is to approximate the hypothetical probability curve by several linear curves. Theoretically, this approach is shown below.



However this approach did not yield any conclusive results. In fact, the problem of overshoot still existed. It is possible that this approach would produce significant results if more time were allotted for testing.

However, it was hopeful that a third approach, which considered the nonlinear shape of the hypothetical probability curve, would render a quicker solution. The shape of the hypothetical probability curve resembles the hyperbolic tangent curve. Whereas the hypothetical probability curve takes on values between 0 and +1, the hyperbolic tangent curve ranged from -1 to +1. It was decided to incorporate the hyperbolic tangent curve into the linear regression package to produce a nonlinear regression. The mechanics of this method are described in Section 2 and Appendix A.

The execution procedure for this nonlinear regression becomes iterative in nature. That is, the regression coefficients that result from the first regression are used as parameters in the second regression; the coefficients from the second regression are used as parameters for the third regression, etc.

The independent variables were the same variables used for the linear regression technique. However, the dependent variable took on a value of either -1 or +1 (for non-accident and accident crossings, respectively) whereas the linear regression had a value of either 0 or 1. The change in the dependent variable only required a simple transformation to produce the probability of an accident.

Since the iterative process is innovative, several behavioral observations should be noted at this point. The number of independent variables should be limited to about six, since a greater number could introduce noise into the regression. As a starting point, the initial values for the regression coefficients for each independent variable may be set to 0. This allows each variable to reflect its original value. During each iteration, the values of the coefficients will change. Some coefficients will migrate and converge toward their final values, while others will migrate in an unsystematic fashion and not converge. Those variables which do not converge on a final value (steady state) are unstable, and should be dropped from the pool of independent variables. When the coefficients approach their final values, a tolerance can be imposed for judging when the iterative process is complete. The tolerance used in this study was based on the standard error of estimate for each coefficient. When the change in coefficient (from one iteration to the next) for all variables was less than 1/10th of their respective standard error of estimates, the coefficients were said to be converged to their steady state and the iterative process complete. One final word of caution: the t values and F values of the regression become meaningless due to the nonlinearity of the regression. Therefore, the acceptance of a variable into the equation is based on the systematic migration and convergence of its coefficient to a final value. Most of the coefficients migrate at a fairly consistent rate of change.

The data base subsets used for the nonlinear regression were constructed quite differently than the subsets for the linear regressions. First, it was decided to construct two subsets of accident/non-accident data; one pair of accident/non-accident data for experimental purposes, and the other pair for validation purposes. These data bases were named the "TEST" data base and the "VALIDATION" data base, but since they were constructed to be statistically and numerically identical, they could be interchanged for testing and validation purposes. A table of the breakdown of these subsets appears in Table F-5 (Appendix F).

It was decided to construct an accident prediction model for each warning device class. It was also decided to construct each model in three phases. The first phase was to consider only volume variables and produce a "best volume" model. The second phase was intended to refine the "best volume" model, shaping it into a polynomial of up to the third degree. The third phase incorporates non-volume variables into an equation with the refined volume model (a polynomial) to produce the accident prediction model or a "comprehensive" model. These phases may be expressed in general terms as shown below.

Phase 1 (Best Volume Model)

$$H = a_0 + a_1 \, LOG_{10}(T + 1) + a_2 \, LOG_{10}(C + 1) + a_3 \, [LOG_{10}(T + 1)]^2$$

$$+ a_4 \, [LOG_{10}(C + 1)]^2 + a_5 \, LOG_{10}(T + 1)*LOG_{10}(C + 1)$$

Phase 2 (Refined Volume Model)

$$HR = b_0 + b_1 H + b_2 H^2 + b_3 H^3$$

Phase 3 (Accident Prediction Model)

$$HI = c_0 + c_1 HR + c_2 X_1 + c_3 X_2 + c_4 X_3 + \dots + c_n X_{n-1}$$

where

a_i, b_i and c_i are regression coefficients

X_i are non-volume variables

T is train movements

C is vehicle movements

HI is the resultant hazard index. (Referred to as "h" in Sections 2 and 4.)

Crossbucks were the first warning device class to be modeled. The series of regression printouts in Table D-5 of Appendix D illustrates how the regression coefficients migrate. This series of iterations is from the "refined volume" model described in phase 2. The iteration was terminated, since the changes in the coefficients are all less than 1/10th of their respective standard error of estimates. It should be noted that the best volume model contained only four terms: the intercept, $LOG_{10}(T+1)$, $LOG_{10}(C+1)$, and $[LOG_{10}(T+1)]^2$. The other two terms, $[LOG_{10}(C+1)]^2$ and $LOG_{10}(T+1) * LOG_{10}(C+1)$, were dropped because their coefficients did not systematically migrate. Thus, for the crossbucks "best volume" model, a_4 and a_5 were zero (from the general equation in phase 2). The equations for the crossbucks "best volume" model and "refined volume" model are shown in Appendix B.5.1. The power factors appear in Table C-1 of Appendix C.

Once the volume model for crossbucks was found, the next step (phase 3) called for the incorporation of non-volume variables. A "selection" regression was developed and utilized to introduce the most effective non-volume variables. The methodology behind the "selection" regression is discussed in Section 2. The "selection" regression is a technique that was developed to indicate which non-volume variables would be most effective at directly predicting accidents in the nonlinear environment. In contrast to the iterative nonlinear regressions, the t values provided by the "selection" regression are true measurements. The selection regressions for crossbucks is shown in Table D-6 of Appendix D. Volume variables appear with non-volume variables in the "selection regression" pool in order to provide different combinations for the comprehensive model as well as to strengthen the volume model if necessary.

After choosing the non-volume terms to combine with the volume model, the regression was iterated until a steady-state solution for the regression coefficients was found. This equation, the comprehensive accident prediction model, is shown in Appendix B.5.1.3.

Power factors were calculated from this comprehensive model to provide an indication of success when measured against the benchmark models (New Hampshire and Coleman-Stewart). The power factors for the crossbucks model are shown in Tables C-2 and C-8 of Appendix C. In order to better illustrate the success (or failure) of the accident prediction model for crossbucks, a plot of the power factors derived from the equation was contrasted against the New Hampshire and the Coleman-Stewart formula. This plot appears in Figures E-9, E-10, and E-11 of Appendix E.

Besides providing a hazard index, one of the features of the accident prediction model is its ability to supply the probability of accidents. Thus, the hazard index may be transformed into a frequency of accident curve. A plot of this transformation for crossbucks is shown in Figures E-1 through E-8 of Appendix E. The TSC model is contrasted against the Colemen-Stewart model for crossbucks. The solid curve represents the performance of the model, while the points, denoted by x's, represent the empirical data.

After the crossbucks model was completed, the three processing phases were repeated for crossings with flashing lights, and again for crossings with gates.

In both the models for flashing lights and gates, phase 2 (where the refined volume model is constructed in the form of a polynomial) is not used. They are constructed this way because the coefficients for the polynomial in phase 2 would not migrate in a systematic manner and converge to a steady state. Therefore, it was deemed that the polynomial was unstable and caused by colinearity. Thus, for both the flashing lights model and the gates model, b_0, b_2, b_3 in the general equation for phase 2 were equal to zero, while b_1 was equal to one.

After the volume models for both flashing lights and gates were obtained, "selection" regressions were run for each warning device class to determine which non-volume variables should be incorporated into the comprehensive equation. The selection regressions for flashing lights and gates are depicted respectively in Tables D-7 and D-8 of Appendix D. After the comprehensive model was iterated, power factors were calculated as well as frequency of accident curves and EOC curves.

The power factors for flashing lights appear in Tables C-3, C-4, and C-9 of Appendix C. Those for gates are in Tables C-5, C-6, and C-10. The EOC plot for flashing lights appears in Figure E-10 of Appendix E and the EOC plot for gates appears in Figure E-11. Frequency of accident plots for flashing lights appear in Figures E-4, E-6, E-7, and E-8 and for gates in Figure E-5.

The last four iterations of the "best volume" model for flashing lights are depicted in Table D-9 of Appendix D. The last four iterations of the comprehensive model (phase 3) are shown in Table D-10. These examples illustrate how the coefficients of the variables migrate toward a steady state. Also shown are the last four iterations of phase 1 and phase 3 for gates. These appear in Tables D-11 and D-12, respectively.

The "best volume" equation and the comprehensive equation for flashing lights are given in Appendix B.5.2. Those for gates are shown in Appendix B.5.3.

As a feature of this study, all three classical models were examined. Tables C-8 and C-11 of Appendix C indicate the power factors of the Coleman-Stewart formula versus the New Hampshire formula and the Peabody-Dimmick formula versus the New Hampshire formula for crossbucks. Coleman-Stewart versus New Hampshire and Peabody-Dimmick versus New Hampshire for flashing lights are shown in Table C-9 and C-12. Tables C-10 and C-13 show both comparisons for gates.

4. RESULTS

As noted in Section 1, the chief objective of this study was to produce a better hazard index. According to the rather rigorous criteria used, this objective was achieved. The magnitude of the improvement may be judged by the reader as to its importance.

Some rather comprehensive displays and comparisons of TSC's new models and previous models have also been produced. The third objective, which was to estimate the limits achievable in prediction models (hazard indexes) for railroad grade crossings, is, of course, almost a philosophical contradiction. There is no way to say that a formula cannot be found which will reliably predict accidents with any arbitrary precision. Nevertheless, the experience and results of this study strongly suggest fairly sharp limits on the power factors achievable with any hazard index. The reason for this is that similar results have been obtained with numerous attempts to find the best hazard index.

Note that in the subsections of this section, frequent reference is made to the appendixes. In particular, the definitions of the various hazard index formulas discussed appear in Appendix B. As each of these formulas is first referred to in this section, the number of the precise formula (or paragraph) in Appendix B is given, e.g., Appendix B.5.1.3. Also, EOC tables and curves and accident frequency curves will be referred to in a similar manner in Appendixes C and E. The reader is urged to turn to each such reference as it occurs, for the first time at least. Appendixes B, C, and E provide the primary empirical result information, and might well be marked by index tabs for ready reference.

4.1 EOCs AND POWER FACTORS

4.1.1 Introductory Comment

As noted numerous times in Sections 2 and 3, the bulk of this project was exploratory in nature: an attempt to find what worked and what techniques yielded the best hazard functions. Therefore, most of the work was concentrated on a single warning device class. Crossbucks were chosen because of the large number of crossings involved. Flashing lights might have been profitably chosen, since that warning device class involved only about one-third fewer accidents and would, therefore, have yielded nearly as precise estimates.

Nevertheless, the objective of this study was to do the whole study for all warning device classes. Preferred methods have been applied, developed from extensive testing on the crossbucks case to the other two warning device classes, flashing lights and automatic gates. The results are shown in the power factors in Tables C-3 to C-7 of Appendix C.

4.1.2 The Crossbucks Case

Table C-2 (see also Figure E-9 of Appendix E) gives the EOC for the best TSC crossbucks model (comprehensive) compared to the New Hampshire (crossbucks) model. (The best TSC models will be discussed below in Section 4.2. They are defined in Appendix B.5.1.3). Remember that the best models are all of logistic construction. The power factors for each percent level may be seen. Thus, if 2 percent of the crossings are chosen, a power factor of about 6 is obtained (PF(.02) = 5.9). If 6 percent of the crossings are chosen, the power factor becomes about 5 (PF(.06) = 4.92, and 6 percent of the crossings have 29.5 percent of the accidents). If 10.5 percent of the crossings are chosen, the power factor is about 4 (PF(.105) = 4.0). At 20 percent of the crossings, the power factor becomes about 3, while at 41 percent it becomes about 2.

To get some idea of how close these are to the best achievable, they may be compared to the New Hampshire power factors. Denoting the power factors for the TSC model by PFTSC and the New Hampshire power factors by PFNH, one notes the data of Table 4-1:

TABLE 4-1. ESTIMATES OF POWER FACTORS AND "ACHIEVABLE" POWER FACTORS (CROSSBUCKS)

% Crossing	PF TSC	PF NH	PF "X"	±
1	7.86	6.80	8.8	10%
2	5.90	6.17	6.4	7%
6	4.92	4.76	5.2	5%
10	4.10	3.83	4.4	4%
20	3.01	2.88	3.3	3%
40	2.03	2.03	2.1	2.5%

The t values (Table C-2) show that the TSC model is significantly better at certain percentage levels, most notably the 9 percent level, where the t value is 4.4. The reader will recall that, as indicated in Section 2.1, a t value of 3.5 is to be considered <u>more</u> than significant (statistically) at the 0.05 level (even though, as in this case, the largest of 100 t values has been selected). Nevertheless, the improvement is small. The improvement is best measured by the percent of the total accidents the TSC model selects over that which the New Hampshire model does. It is seen that this is a maximum in the 8-10 percent range, where it is 3 percent of the accidents (out of about 40%, which are picked up by both models). Therefore, at the point of most favorable comparison, the TSC model is <u>relatively</u> about 7-8 percent better.

It may be expected that any other model would be better than the TSC model by no more than the TSC model is better than the New Hampshire model. This statement cannot be proven, and is only approximate. It may overestimate or underestimate the maximum achievable. The column labeled PFX would represent this crudely estimated bound on the ultimately attainable power factors. The reasons for surmising that PFX may represent the best attainable are:

a. The large amount of experimentation and testing done leads one to suspect that the TSC model is near the best.

b. The improvement achieved over the simplest good model (New Hampshire) is relatively small, and, therefore, would be expected to estimate in order of magnitude an upper bound on what is left for improvement.

In practical terms the improvement achieved -- about 3 percent more of the accidents identified (out of 40 percent total for both models) for 10 percent total crossings chosen may or may not be considered pratically significant. If the hazard index were being used only at this level, then upwards of 3 percent of all accidents (at crossbucks) could be anticipated (by the new model over and above the New Hampshire model) and thus avoided by upgrading the warning equipment at the crossing. This could amount to many accidents over many years. However, in general, other information may be available than is used by these formulas, and, in this case, they may be expected to be used mostly for preliminary screening, so that accuracy would not be such a large factor. Incidentally, as noted in the column ± (i.e., absolute percentage errors in an estimated power factor) in Table 4-1 above, the power factors as estimated here are about as uncertain in the absolute magnitude* as is the difference between what is estimated to be the power factor of the best model and the power factor of the best attainable model.

In cases where the hazard models are to be used for final selection of crossings for improvement expenditures for whatever reasons (such as objective formula required by law), then the roughly 3 percent more accidents which may be "pre-identified," i.e., anticipated or predicted by the TSC model over and above the New Hampshire model, could be of considerable interest. As further aids in interpreting and understanding the power factor information in the EOC, Appendix E contains plots of EOC curves (which give percent accidents vs. percent crossings) for various models and warning device classes as indicated. The relatively small

*This quantity, which appears in the column headed "±", is $1/\sqrt{\text{CUMACC}}$ expressed as a percent. CUMACC is in column 3 of the C tables. Thus, $\pm = 1/\sqrt{\text{col } 3} \times 100\%$. This number has been rounded up for Table 4-1 to be conservative.

but noticeable improvement of the best TSC models over the previous models can be observed.

Analytic Power Factor Curves

Tables C-1 to C-6 also present data on single parameter representations of entire power factor curves. Since power factor curves are empirically determined, they are inherently noisy (see Figures E-9 to E-11). An analytic expression can remove this noisiness to facilitate power factor estimates and comparisons. Such expressions can be used to estimate power factors without having the entire tables at hand, and also to interpolate and extrapolate. They are also used to obtain accident frequency estimates below.

The numbers labeled CON1, CON2, etc., in Tables C-1 through C-6 are "constants" appropriate for four empirical formulas for power factors. Let λ be the percent level expressed as a fraction, and ρ the power factor at the level. Thus, $\rho(.1) = 2.1$ means "the 10% power factor is 2.1." The four functions of ρ,λ are:

A) $$\frac{\rho}{\log \lambda} = C1$$

B) $$\frac{1}{\log \rho} + \frac{1}{\log \lambda} = \frac{1}{C2}$$

C) $$\frac{\log \rho}{(\log \lambda)^{.5}} = C3$$

D) $$\frac{\log \rho}{(\log \lambda)^{.75}} = C4$$

These functions are chosen on a rationale that $\log \rho$ and $\log \lambda$ are simply related. This result can be derived theoretically under certain assumptions. Since ρ is a function of λ, then C1, C2, C3 and C4 are also functions of λ. They are tabulated in Tables C-1, etc. as "CON1, etc." Insofar as any of the functions are approximately constant, then the appropriate function gives ρ as an implicit function of λ. Thus, if C4 is observed to hold rather constant (in a given EOC) for a whole range of λ, then $\log \rho = C4(\log \lambda)^{.75}$ represents the EOC or power factor curve. Notice that for each "constant" C1, C2, C3, C4, $\partial\rho/\partial C1 > 0$, $\partial\rho/\partial C2 > 0$, etc., so that the larger the value the "better" the power factor curve. Thus, if two hazard indexes can be given the same representation with different values of C1, C2, C3, etc., then the hazard index with the larger value (of C1, etc.) is better. It can be seen that the forms $\log \rho = \alpha(\log \lambda)^{\beta}$ give the best fits. Later it will be shown what values of α and β to use, and further uses for the power factor formula. (See Subsection 2.3.2.)

4.1.3 Flashing Lights Case

Table C-3 shows a comparison of the power factors for volume-only hazard index for the flashing light warning device class versus the New Hampshire hazard index. (See Appendix B.5.2.2 for the definition of the TSC flashing lights volume-only model.) It should be remembered that all best TSC models reported in Section 4 are of logistic construction.

The volume model is roughly no better and no worse in ranking crossings than the New Hampshire formula. In fact, they come quite close to giving the same ranking. The practical distinction between the two formulas is that the TSC hazard index h yields the absolute hazard index C_1e^{2h}, as noted above. This makes the TSC volume model suitable for adding on non-volume terms. (This surprising assertion is discussed in Section 2 and in the CMR.)

Even with the non-volume terms added in, the TSC model is only slightly better than the New Hampshire model, as can be seen in Table C-4 (a maximum of 2% absolute or, in other words, "2 percentage points" difference at the 16% to 18% level).

The conclusion here, as with crossbucks, is that a slight improvement over the New Hampshire formula is possible; a two-percent reduction in accidents could certainly be well worth considering. However, these formulas are very likely not as efficient as professional judgement with an on-site inspection by local authorities. Thus, a small difference in efficiency (as measured by the power factor), although important absolutely on a national basis, could be insignificant in the use of the formula for a pre-screening process.

The scantiness of the improvement again gives evidence that the TSC model is near the ultimate. Table 4-2 lists the power factors (they should be considered in the PF1 sense for the 1975 accidents) for the TSC model, the New Hampshire model,and, as a guess at an upper ground, for the ultimate attainable:

TABLE 4-2. POWER FACTORS (FLASHING LIGHTS)

% Crossings	PF TSC	PF NH	PFX Ultimate (guess)
1%	7.55	6.72	8.5
2%	5.74	5.44	6.1
5%	4.35	4.12	4.6
10%	3.48	3.32	3.7
20%	2.62	2.59	2.7
30%	2.09	2.11	2.2

Again, what the "ultimate power factor" might be is an "educated guess." At the same time, the experience of many fruitful (and fruitless) attempts would have one believe in the stability of performance of good reasonable models on these data; it would be remiss not to impart a sense of the knowledge which was gained from this experience.

A comparison of Table C-4 with Table C-2 shows that power factors for flashing lights are smaller than those for crossbucks. This says that the dependence of relative probability of accident on the factors in the crossing inventory is stronger for crossbucks than for flashing lights. Roughly speaking, high car and train volumes have a larger relative effect (multiplicative) on the probability of accident at crossbucks than at flashing lights. The absolute probability of accidents is considerably smaller at crossbuck than at flashing lights (with similar volumes), but the volume dependence is more pronounced for crossbucks.

4.1.4 Automatic Gates Case

The last warning device class for which results are given in this report is automatic gates. Here the sample size is so small that the results must be treated cautiously. There were only slightly over 700 accidents at gates, giving about 350 for both data bases. The power factors comparing the TSC volume model with the New Hampshire model are shown in Table C-5. The fact that at some places the TSC model gets up to 6 percent more of the total accidents (at 50 percent of the crossings, TSC gets 80.5 percent of the accidents, while the New Hampshire model gets 74.9 percent of the accidents) should be treated cautiously. The statistical significance is not as high as might be desired. The evidence for this is that New Hampshire catches up to TSC at 32.5 percent, and even goes ahead by nearly a full percentage point after dropping over 4 percent of the total accidents behind at 17 percent of the crossings. However, there is evidence that the TSC formula performs better.

Adding in the non-volume variables makes the case stronger at the lower percentages (below 35% of the crossings), where the formula is expected to be of more use; this improvement is at the expense of poorer performance above 35 percent. (Compared to TSC volume only, it remains better than New Hampshire.) Table C-6 gives power factors for the TSC comprehensive models for gates. Although it gives up to 6.5 percent improvement over New Hampshire at some levels, the variability of quality of performance makes it appear that the amount of improvement in quality is very hard to estimate. The TSC model is evidently about equal to the New Hampshire model in the region of 6% to 15%, a conceivably very important region in application. It is not certain that statistically significant improvements have been obtained; in other words, the 6-percent improvement over New Hampshire in the gate category is much less significant than the 3-percent improvement in the crossbuck category.

In spite of all the variability and imprecision of the gates power factors (because of the small number of accidents), Table 4-3 lists the following estimated power factors.

TABLE 4-3. ESTIMATED POWER FACTORS (GATES)

% Crossings	TSC Power Factor	NH Power Factor	Ultimate PFX
2	3.8-4.8	3.4-3.6	5.5
5	3.4	2.8	4.0
10	2.7	2.7	3.0
20	2.2	2.1	2.5
30	1.9	1.9	2.0

4.1.5 An EOC over the Full Flashing Lights Data Base

All the power factor tables (EOCs) presented in Appendix C were calculated on random subsamples of the data base (crossing inventory + accident file). One EOC was calculated on the basis of all relevant data. This was primarily to exhibit the consistency of the sampled data EOCs. Table C-7 shows an EOC for the New Hampshire model for flashing lights. It is calculated on the basis of all public flashing light crossings and all 1975 public flashing light crossing accidents. Table C-3 gives the same information for a sampled data base containing 50 percent of the accidents and a sampling of the crossings. The agreement is quite satisfactory. Since Table C-7 is based on 2,650 accidents and Table C-3 on 1,324 accidents, one can see that Table C-7 should have approximately twice as many (plus maybe 1 or 2) accidents at each level, as has Table C-3. Table C-3 has 198 accidents (for New Hampshire) at the 3-percent level, while Table C-7 has 392 accidents (2 x 198 = 396). The difference of 4 accidents out of 392 is quite small.

At the 10-percent level, 893 accidents in Table C-7 compares with 2 x 440 = 880 accidents in Table C-3. The difference of 13 is small compared to 893. In general, the difference between the accidents in Table C-7 and twice those in Table C-3 could reach as high as 60 without there being a significant difference. The difference doesn't reach this size, and in general there is no evidence for any statistical difference between the two.

In Table C-7, extra data are given for interpreting equation

$\log \rho = \alpha(\log \lambda)^{\beta}$.

Values of $\alpha = \frac{\log \rho}{(\log \lambda)^{\beta}}$ for the values of β:

β = .65, .70, .75 and .80 are given in the columns headed **.65, **.70, etc.

The next-to-last column is $\Delta \log \log \rho / \Delta \log \log \lambda$ figured over 1/2 percent intervals in λ, while the last column gives averages over groups of seven of the latter quantity. It can be seen that for the New Hampshire flashing lights case, β ranges from a stable 0.7 to a stable 0.8. Therefore, using $\beta = 0.7$ (as in Figure E-7) can be expected to underestimate f for values of $\lambda \times 100\% > 25\%$, but should otherwise do rather well. (See Table 2-2.)

4.1.6 <u>Evaluation of Other Previously Proposed Hazard Indexes</u>

Continuing with the comparison of relative hazard indexes, the classical Peabody-Dimmick formula and the Coleman-Stewart formulas will be considered. As with the comparison of the TSC formulas with the New Hampshire model in Subsections 4.1.2-4.1.4, the comparisons in this sections will all be of the EOC type; thus, the models will be compared as <u>relative</u> hazard indexes, i.e., with respect to their ability to rank crossings according to hazard. Tables C-8 to C-13 present comparisons between Coleman-Stewart models and the New Hampshire formula, and between the Peabody-Dimmick formula and the New Hampshire formula for the three warning device classes considered. Comparisons with the TSC models are omitted, as the TSC comprehensive models outperform the Coleman-Stewart models tested here (those from Reference 2 for the three warning device classes) and the Peabody-Dimmick formula as well as the New Hampshire formula for all three warning device classes. Further, the New Hampshire formula is, for the most part, somewhat better than the other two models as measured on these data and exhibited in Tables C-8 to C-13.

The reason why the New Hampshire model is superior to the Peabody-Dimmick is probably that the train volume appears to a lower power than car volume in the Peabody-Dimmick formula, while the evidence indicates that the train volume should appear to a higher power.

The superiority of the New Hampshire formula over the Coleman-Stewart models is difficult to explain. It may be related to Coleman-Stewart's use of four distinct formulas to produce one relative hazard index. Thus, if the normalization, i.e., scaling factor, is slightly off for one formula relative to another, the performance as a relative hazard index is thrown off. To put it differently, since a different formula is used for each state of the urban/rural and single/multiple track variable, there is a need for the formulas to perform accurately as absolute hazard indexes in order that they may perform effectively in concert as a relative hazard index. Accuracy of an absolute hazard index is difficult to achieve (see Section 4.3), and so the effectiveness as a relative hazard index is impaired.

Earlier in the project, when some models were tested which were constructed by Coleman-Stewart and which contained the urban/rural and single/multiple track variables directly in the formula, the hazard indexes appeared to perform somewhat better than the New Hampshire model, although somewhat poorer than the TSC models. Such results cannot be reproduced and included here because of time constraints. The models were, as has been indicated, no better than the TSC models, and their form aided in suggesting forms for the optimum TSC models.

In summary, Tables C-8 through C-13 indicate that the New Hampshire formula provides a relative hazard index superior to that of the other two families of previous models. It follows, then, that the TSC models, since they have already been described as superior in accuracy to the New Hampshire model, are likewise superior to the other two models.

Figures E-9 through E-11 of Appendix E show graphically the effectiveness of the TSC, Coleman-Stewart, and New Hampshire models in terms of relative hazard indexes, which, in turn, are manifested as respective EOCs in the figures.

The following points are pertinent to the definition of the formulas:

1. The Peabody-Dimmick formula, as it occurs in the original article, amounts to a complex function of $C^{.17} \cdot T^{.15}$; but since this complex function is strictly increasing (monotonic), $C^{.17} \cdot T^{.15}$ is equivalent to the complete Peabody-Dimmick formula for use as a <u>relative</u> hazard index (such as the comparison in this subsection relates to).
2. The New Hampshire formula has a warning device class factor, but this can be ignored here, as the comparisons are limited to single warning device classes.
3. The Coleman-Stewart formulas are, strictly speaking, undefined if either C or T is zero. This is resolved here by taking C = 1/2 and T = 1/2 respectively in the zero cases. (Actually, T = 0 represents the case when the inventory form had a zero for each of items 24, 26, 28, and 30 of Table F-2.)

4.2 DISCUSSION OF TSC COMPREHENSIVE MODELS AND VOLUME MODELS

4.2.1 Crossbucks

The volume model requires little discussion (see Appendix B.5.1.1 for definition). It provides a ranking of the crossings which differs little from the New Hampshire model, and in the effectiveness or predictive value of the rankings, differs by still less. The chief purpose of the complexity of the volume model is to ensure that the hazard index becomes an absolute hazard index. It is noted in Section 2 that this is a necessary property for discriminants to ensure their optimal construction. In other words, unless a good estimate of the actual probability can be worked out, it is not possible to construct the best discriminant (hazard index) even from the relative point of view.

Since some of the terms in the hazard index have negative coefficients, it is good to check that the hazard index is an increasing function of the car and train volume over a sufficiently wide range. In this connection, $\partial h_v/\partial c < 0$, for all values of c, but $\partial h_v/\partial T > 0$ only when $1.158 - 2. * .2212 \log_{10}(T+1) < 0$, or $T > 414$. So, if there are more than 414 trains per day, the hazard index starts to decrease with increasing train volume, but not before. The decrease is very small; for example, doubling the number of trains (to 828) decreases the probability (frequency) estimates by less than 1 percent of its value, i.e., the relative decrease is 1%. Of course, the estimates are not valid at these very high train volumes. A separate analysis would be required to estimate the dependence of hazard on very high train volumes. The point of this discussion is to verify that the negative coefficient of $[\log_{10}(T+1)]^2$ does not result in a decrease in estimated hazard at ordinary train volumes. The non-volume terms that were selected by the selection regression (and not dropped later due to shrinking contribution) are more notable.

Besides the volume term there are (see B.5.1.3):

1. The logarithm of the number of day through-trains (plus 1): (positive coefficient).
2. The number of main tracks: (positive coefficient).
3. Is the highway paved? (positive coefficient).
4. Population (see Appendixes B and D for definition of the variable): (positive coefficient).
5. Function class of the road (see Appendix F for definition of this variable): (negative coefficient).

As stated in Section 1, the goal of the study was predictive effectiveness and not identification of the causes of accidents. Therefore, caution must be exercised in interpreting these terms as causally connected with accidents. However, the terms are all intuitively reasonable as contributors to accident probability (taking into account the sign of the coefficient).

The positive connection of accidents to day through-trains is perhaps the most obvious. Since "volume" variables are based on total average vehicular traffic and total average train traffic, it does not take into account extra exposure of day trains to higher day traffic; therefore, an extra term for day trains is to be expected.

The positive term for number of main tracks is, likewise, evident, especially since many accidents occur involving slow or stalled vehicles, and some involve vehicles not seeing trains masked by other trains.

The positive correlation with the highway being paved would seem harder to explain. Perhaps this ends up being a proxy variable for vehicle speed. Because of the volume optimization and presence of track and lane variables in the variable pool, it should be no more than a partial proxy for them (the same holds for functional class). However, a road that is not paved would very likely carry cognizant local traffic at lower speeds than would a paved road with the same vehicular volume.

The population variable is also tricky -- the higher the population, the higher the risk. This is likely tied up with the correlation of sight distance with population. One finds that population is a better predictor than urban/rural, so population is probably a proxy for urban/rural, even though urban/rural was part of the variable pool available to the stepwise regression. Population is probably also a proxy for percent familiar drivers. The demographic implications of this variable could provide endless speculation. Functional class is perhaps a proxy for lanes, vehicle speed, percent familiar drivers, etc.

4.2.2 Flashing Lights

The flashing lights comprehensive model is given in B.5.2.2. It involves exactly the same non-volume variables as crossbucks and with the same signs for the coefficients, except for the added term "number of highway lanes" replacing the "highway paved" variable. This is very reasonable on two counts:

a. The more lanes, the more likely the driver is not to notice the flashing lights.

b. In the case of flashing lights, the variable "highway paved" is not very useful, since it almost always has the same value. Number of highway lanes then becomes a reasonable proxy for the same set of conditions.

4.2.3 Automatic Gates

The automatic gates comprehensive model is contained in B.5.3.2. In this case the smaller sample size supports the incorporation of fewer variables into the model. The selection regression used to select the variables for the automatic gate model is given in Appendix D, Table D-13. It is interesting to examine the regression at step 4, step 6, and again at step 10. At step 4 it can be seen that the first variable chosen (at step 1) was "presence of railroad advanced warning signs." This enters with a negative sign. In other words, if the advance warning signs are present, the crossing is more dangerous. This class of phenomenon may be called the warning device level paradox (or perhaps the Coleman-Stewart paradox).

This paradoxical phenomenon is fairly widespread in safety analysis of this type, and bears some discussion. The characteristic of interest (in this instance and in certain others) is that the "higher warning device level" crossing is more hazardous than the "lower warning device level" crossing, even accounting for other factors. The warning device level variable has become a proxy for "local judgment." In other words, if the higher warning device level is present, this reflects a judgment on the part of someone that the crossing warrants the warning equipment, perhaps based on factors not in the data base used here, including past accident history. The other element necessary to produce the paradoxical situation is that, on the average, the effectiveness of the extra warning device does not offset the increased hazard implied by its presence. In the case of the "RR advance warning sign," this is especially likely to be true, since it presumably is of low effectiveness but is also relatively inexpensive.

Coleman-Stewart noted the paradox (if not this explanation) in connection with flashing lights and gates under certain conditions and a similar anomaly was noted in the California report (Reference 1). The variable "RR advance warning signs present" is not included here mostly because of the odd nature of its promised contribution. If more time had permitted, it would have been included in a final model, since it does add to predictive power, and that is what is desired. In general, a paradoxical variable is usually a proxy for some other variable, so that including it will improve predictability; however, it can also either improve or reduce one's ability to give a causal interpretation of the model.

Step 6 of Table D-13 shows that a number of variables have entered the regression. "Number of lanes" and "number of main tracks" were chosen because of their relatively large t values. The variable $[\log(C+1)]^2$ could have been included, but since it is a volume variable and, therefore, only adjusting for the addition of the other variables (not all of which would be kept), and since the sample size is small (supporting few variables), it was, decided to keep only the tracks and lanes variables and the "variable" 1, i.e., a constant. The constant has already been chosen by the volume regression, but with only two other non-volume variables, the inclusion of a constant term is surely advisable. (Many "blind alleys" and abandoned attempts have shown the advantages and disadvantages of including the constant term.) It is probably always advisable to include it on theoretical grounds, and it was left out of the models only when the power factor showed it did not help. Looking at step 10, one sees that the constant "1" entered only on the 8th step. Some of the t values of step 10 are so small that interpretation is problematical.

The positive dependence on night trains need not be interpreted, even though it is contrary to the positive dependence on day trains for crossbucks and flashing lights. All variables which entered those models had much larger t values in the selection regression.

Next to be considered is what did not show up in the models. The gate selection regression variable pool (Table D-13) shows the most important ones. Considerable experience had led to the dropping of other variables previously as especially unpromising. "Crossing angle" is a notable one. Nearly every selection regression contained that variable to no avail. The variable was just not pertinent to any of them. However, it should have been included in the variable pool for gates in spite of its lack of usefulness for crossbucks. But this oversight is unlikely to be of any significance.

Of the variables shown in Table D-13, "maximum train speed" (variable 10) was an example of a variable that was carried in virtually every selection regression to practically no avail. It never entered the gate selection regression shown in the table except at a very late step with completely insignificant t value. It entered selection regressions for flashing lights and crossbucks, but at late steps, with too small t values to justify keeping the variable for prediction purposes, but probably large enough to prove its significance. It entered with a positive coefficient. Apparently, "max speed," which is better than the other two variables representing train speed, is of ambiguous value for determining accident hazard. On the one hand, the faster the train, the more likely for the train to strike the car because of lack of warning (of more importance for crossbucks and flashing lights). On the other hand, the slower the train, the more likely the car is to strike the train. (Notice also that the train speed is a proxy for number of cars in the train.) The two effects evidently cancel in the case of gates and partially cancel in the case of lower warning device classes, with slight tipping of the balance to higher hazard for higher speed. If accident severity or just fatal accidents had been considered instead of all accidents, the finding might have been completely contrary.

It should be noted that the variable "urban/rural" was forced out of the regression in Table D-13. This variable was always passed up in favor of "population" in the case of selection regressions for crossbucks and gates. Various indications led to <u>suppressing</u> it from this regression since it had entered another gate selection regression (see Section 3), and since the other variables seemed to perform better in its absence. This kind of judgment sometimes led to choices that were not dictated by the selection regression, but as far as possible the EOC was, as noted in Section 2, the final arbiter.

4.3 EXPECTED ACCIDENT FREQUENCY PLOTS

It has been noted that there is need in some contexts for an absolute as well as a relative hazard index. An absolute hazard index is one which is proportional to the expected frequency of accidents each year at the given crossing. It has been indicated that the expected accident frequency can be estimated in a number of ways. In Appendix E plots are presented which show a comparison of the expected accident frequency as computed four ways:

a. $$f_1 = r \frac{M}{N} \rho \left(1 + \frac{\log \rho}{\log \lambda} \beta\right)$$

The second term within the parentheses is considered negative. (See Table 2-2 and Section 2.3.)

b. $$f_2 = \frac{M}{N} \frac{\Delta \text{ \% Accidents}}{\Delta \text{ \% Crossings}}$$

where Δ % accidents is the percentage of all accidents occurring in a 1-percent interval of crossings:

$$\Delta \text{ \% Crossings} = 1\%$$

c. $$f_3 = C_1 e^{2h_{TSC}}$$

where h_{TSC} is any one of the TSC hazard indexes. The formula for f_3 is given in Section 2.3.1. The value for h_{TSC} can be obtained from any of the following formulas, depending on warning device class and on whether the non-volume variables are to be used:

B.5.1.2	B.5.2.1	B.5.3.1
B.5.1.3	B.5.2.2	B.5.3.2

The constant C_1 is determined by normalization, so that the cumulative number of (predicted) accidents over the 50 percent most hazardous crossings agrees with observation. Alternatively, the values of C_1 given in Section 2.3.1 can be used.

d. $f_4 = k\ e^{h_{cs}}$

where h_{cs} is the appropriate Coleman-Stewart model (see Appendix B) and k is determined as in c. above by normalization.

The quantity f_2 (see b. above) is the observed empirical frequency of accidents in a given interval (of ranked crossings). Consequently, the other formulas are especially to be compared to this one. When the estimate provided by f_2 jumps around a lot, the other frequency estimates, which are strictly decreasing, are accurate if the "empirical" estimates average around the "theoretical" estimates. (By empirical f_2 is meant, and by theoretical f_1, f_3, and f_4 are referred to.) Also, when any two of the estimates tend to agree, this is confirmation for both estimates, since they are derived and calculated by quite different methods.

For example, Figure E-1 of Appendix E compares the frequency estimates for the TSC comprehensive crossbucks model, as given by formulas f_1 and f_3. The solid line represents f_3 and the X's represent f_1. It is not really possible to say which gives the better estimate (indicated below will be how this can be resolved with a little more analysis). It appears that the agreement is rather good, especially in the 5 percent to 30 percent region.

Figure E-2 is for the same hazard index (TSC comprehensive cross-bucks). The formulas represented are: f_3 by the solid line and f_2 by the X's. Of course, f_2 estimates the "true" values in the sense of unbiased but it is quite noisy.* Given that f_2 is unbiased, it seems that f_3 is <u>not</u> underestimating out near 50 percent and is as good as the eye can distinguish for low percentage

*"Noisy" = "has large random component." This quality is evident in the figure.

(high hazard) crossings. It may be assumed that f_3 gives rather good probability estimates.

Figure E-4 provides the same comparison for the TSC comprehensive flashing lights model. The agreement is as good as the eye can suggest for a strictly decreasing smooth function (except possibly below 5%).

Figure E-5 provides the same comparison (f_2 vs f_3) for the TSC comprehensive automatic gates model. The large scatter is consistent with the findings of large variability of estimates in the automatic gates case. The agreement is difficult to assess.

Figure E-7 is the f_1, f_2 comparison for the New Hampshire model in the flashing lights case. In earlier work it was shown that the New Hampshire formula H=CT does not provide an absolute hazard index directly, so something like an f_1 estimate is necessary. In Figure E-7, f_1 and f_2 are represented by the solid line and X's respectively. The agreement is about as good as the eye can suggest (β was taken to be 0.7).

Figure E-8 is also for the flashing light case, but compares f_1 and f_2 applied to the TSC model. (In f_1, β was set to 0.7 again.) The agreement is as good as the eye can tell. Referring to Figure E-4, it can be seen that f_3 perhaps overestimates for low percentages. Figure E-8 shows that f_1 estimates smaller values in the same region. In this case, f_1 may be a better frequency estimator than f_3.

Figure E-3 is for the Coleman-Stewart crossbucks model, and Figure E-6 represents the Coleman-Stewart flashing lights model. Note that in the crossbucks model the Coleman-Stewart formula, normalized to this data base, fits the empirical frequency points relatively well.

It might appear that the Coleman-Stewart crossbucks formula is as good an absolute hazard index as the TSC (comprehensive) crossbuck formula. However, the closeness with which the curve matches the empirical frequencies is not the only test. The other consideration is how much of a differential spread in frequencies the formula creates. Thus, a formula that simply assigned the same average accident frequency to all crossings would match the empirical value almost exactly, but would be useless as an absolute hazard index, since it contains almost zero information. The TSC crossbucks formula results in more of a spread, as evidenced by a more sharply rising curve (compare Figure E-2 with Figure E-3), and thus is apparently more useful as an absolute hazard index. The sharper frequency curve is reflected directly in the fact that the TSC formula has higher power factors.

The Coleman-Stewart flashing lights model (Figure E-6) has a high spread of empirical frequencies about the formula curve. This is probably partially due to a mismatched combination of the four formulas which make up the Coleman-Stewart model for this warning device class*, and thus gives added evidence that separate formulas may be giving trouble when used to compare crossings. The use of separate (TSC) formulas for separate warning device classes is all right under either of two circumstances:

1. No cross comparison between warning device classes is made.
2. The crossings are compared over the whole population on which the hazard indexes are constructed and calibrated (the entire United States).

In other cases, a single combined formula for all warning device classes might be considered (with warning device class as a variable). Such a formula has not yet been constructed (using our technique).

The Coleman-Stewart flashing lights formula also results in a less sharply increasing curve than the TSC flashing lights formula.

In general, the frequency estimating formulas f_1 and f_3 are fairly accurate. Formula f_3 is probably good within $\pm$ 10 percent for the flashing lights and crossbuck cases. It is difficult to evaluate these frequency estimates. A careful analysis using the

*The four formulas involved for each warning device class are shown in Appendix B, Section B.1. The fact that distinct formulas are used to compare distinct crossings is the issue in point.

exact formula

$$f = \frac{M}{N}\rho\left(1 + \frac{\log \rho}{\log \lambda}\,\frac{d \log \log \rho}{d \log \log \lambda}\right)$$

(see Subsection 2.3.2) could be undertaken with the data available. The assumption above has been that

$$\beta = \frac{d \log \log \rho}{d \log \log \lambda}$$

is a constant. The other definition of β is the value that makes

$$\frac{\log \rho}{(\log \lambda)^{\beta}} = \alpha$$

stay constant. In general, β will not be constant, but a function of λ. β may be determined by best fit locally of $\Delta \log \log \rho = \beta \Delta \log \log \lambda$ or, according to an alternative hypothesis, $\Delta \log \log \rho = r \Delta \log \log \lambda + s \Delta \log \lambda$ for which $\beta = r + s \log \lambda$. β or r and s can be fit locally over several percent (to smooth out the noise). Although there was not time to do this analysis for this report, it can nevertheless be surmised that the estimated accident frequencies already reported will be useful even if estimated to within about 10 percent.

It seems almost unreasonable to predict these rare events more accurately. Furthermore, it might be suggested that most selection processes, whether they be real or hypothetical for analysis purposes, can be based on power factors rather than on probabilities (frequencies). It should be remembered that when power factor ρ is associated with a hazard index value h (assuming λ is known as well, i.e., h selects λ x 100% of the crossings), then one has the answer to the question of the number of accidents that are to be expected in the next year at the λ x N crossings with this or greater hazard index (in the given warning device class). On the other hand, if "f," is known one has the answer to the question of the number of accidents that can be expected at a crossing with this value of "h" in one year. It is difficult to know what the comparison is of the errors in ρ with those in f; the error in ρ may have been overestimated or underestimated in f.

In general, f estimates the derivative of a random function and, therefore, cannot be known as well as ρ, which is based on cumulative quantities only.

4.4 SUMMARY OF RESULTS

With a data base of unusually large size and degree of completeness, and with the statistical tools for constructing, testing, evaluating, and exhibiting properties of hazard indexes, a number of things have been quantitatively demonstrated about hazard indexes for railroad crossing accidents that could not be done under other circumstances.

Extensive experimentation has been done, on the basis of which three comprehensive models are offered; these models are also tested and compared in performance to other hazard indexes on the overall United States accident experience for 1975. Extensive tests and analyses have been performed to provide clear and specific information on what these hazard indexes indicate; in this regard, some similar analyses were performed on earlier simpler hazard indexes.

It has been shown by extensive experimentation and tests that simple volume-dependent formulas appear to have 90-95 percent of the predictive power of more complex formulas. Of volume-only formulas, the New Hampshire hazard index for a given warning device class gives nearly as good a ranking as an optimized formula. However, the straight formula H = k CT should not be used to estimate accident frequency. In this regard, Table 2-2 and the discussion in Subsection 2.3.2 show how to convert a value of CT (average daily vehicular volume times average daily train volume) into a power factor and also an expected accident frequency.

The new formulas that are derived are, in certain respects as described above, more selective than the New Hampshire formula, even though the difference, while statistically significant, may not be considered large enough in certain applications to forgo the simplicity of the New Hampshire formula. If the TSC comprehensive formulas are used, they too may be converted into expected frequency of accident by simply forming C_1e^{2h}. The value of h x 10,000 is listed under the column HAZARD INDEX, TSC in the EOCs (Appendix C); the New Hampshire hazard index value given is simply CT.

Finally, it has been shown explicitly how the power factor and expected frequency of accidents change and what values they take (for the three warning device classes -- crossbucks, flashing lights, and gates) when a given percentage of the most hazardous crossings is chosen. This information is in the EOC tables and in the fitted formulas relating f and ρ to λ.

The techniques used have been exceptionally effective in illuminating the quantitative aspects of hazard as predicted by simple quantitative characteristics. However, there has not been time to realize all of the intended applications of these constructions and tests. Indeed, a very major product of this project consists of the tools and techniques and procedures which were found useful. Further use of these tools and similar techniques will no doubt sharpen the picture that has been produced.

In the near future hazard indexes that use accident history of the individual crossing to help determine hazard are expected to be developed. (See Appendix H for details.) Preliminary results indicate that accident history can be of great predictive value when combined with the other factors considered in this report.

Finally, the reader or the user of information in this report must be cautioned that the work presented here is more of the nature of "experimentation" than of "production." A great deal of care has gone into ensuring the accuracy of the results shown, but all the data and formulas should be considered subject to refinement as more experience and data are gained.

5. SOME PRACTICAL CONSIDERATIONS

The practical worker is faced with two questions:

a. Which hazard index to use?

b. How is it to be used?

5.1 SELECTING A HAZARD INDEX

The informal recommendations given in this section will not substitute for a more thorough appraisal based on a reading of the whole report, but may help get the worker started on the task.

For choosing a hazard index, one needs to ask the following questions:

1. What information is available for the construction of the hazard index?
2. How much complexity in the formula is feasible?
3. How important is accuracy?
4. Is an absolute hazard index (frequency of accidents per year) necessary, or is a relative hazard index sufficient (for ranking crossings by relative hazard)?

Now one needs to focus on a particular warning device class (crossbucks, flashing lights, or gates). Suppose that only volume information is known, i.e., average daily number of vehicles over the road and average daily number of train movements. The simple New Hampshire formula is available for relative ranking within a warning device class, but if an absolute hazard index is needed, <u>or</u> if the moderate complexity of the TSC volume formulas is not a sufficient drawback, then a TSC volume formula is to be used. So, with volume-only information, if (a) an absolute hazard index is indispensable, such as for an absolute comparison of hazard between warning device classes or for use in a cost/benefit ratio, <u>or</u> (b) the complexity of the TSC formulas is not considered a serious drawback, i.e., the calculations can be done with ease, then it is necessary to use one of the TSC best volume formulas as follows: for crossbucks one uses B.5.1.1 (Appendix B); for flashing lights one uses B.5.2.1; and for automatic gates one uses B.5.3.1. If, on the other hand, a simple formula is desired, and accuracy differences within a small percentage range are tolerable, and an absolute hazard index is in no way necessary, then one uses the simple New Hampshire formula.

Now, suppose other information is available besides vehicular volume and train volume. In this case, one has to check the relevant TSC best comprehensive formulas: for crossbucks, B.5.1.3; for flashing lights, B.5.2.2; and for automatic gates, B.5.3.2. One sees if all the information required for these formulas is available; for example, if the warning device class is gates, then the number of highway lanes must be known for each crossing. This information resides in the FRA data base (see Sections 1 and 3 and Appendix F), and will be available from that source if from no other. If all the information required by these formulas is available, then use of these foumulas is suggested. If not, then one needs to decide whether a volume-only formula is satisfactory; for this decision, the discussion in Section 4 concerning the EOC tables of Appendix C may be helpful. In general, use of the comprehensive formulas when one or more data items are missing for each crossing, or for most crossings, is not to be recommended. At the same time, there is no evidence that a reasonable attempt along these lines is sure to be unsuccessful.

If there are some data items (quantified crossing features) available on the crossings to which the hazard index is to be applied but not represented in the FRA data base, e.g., "clear sight distance down track," then the question as to how these items should be treated has, of course, not been directly answered. But after reading this report, the user may be reluctant to assign a large effect to any additional non-volume variables (except accident history, considered below). It should be remembered also that any additional variable will, in general, already have been partially accounted for by other variables acting as proxy.

This report has stressed that accident history at particular crossings is probably of great importance if available. We are not yet ready to report on hazard indexes involving accident history, but Appendix H shows how they can be constructed by use of the same data base of accidents and crossings.

5.2 USE OF THE HAZARD INDEX

Next to be considered is the practical use of the hazard index. It seems that this always involves carrying out some form of the following basic procedure:

1. Rank all the crossings under consideration according to the value of the hazard index. (This ranking is probably most reliable if all the crossings of only one warning device class are considered at one time. If crossings of two or more warning device classes are to be ranked together, i.e., interspersed, then it is essential that an absolute hazard index proportional to expected accident frequency be used.)
2. Select from this ordered list of crossings under consideration a specific number or a specific percentage (proportion) for some action, e.g., improvement of crossing warning equipment.

Relative or Absolute Hazard Index

Now, to convert a relative hazard index to an expected frequency of crossing (or an absolute hazard index), it is necessary to employ some transformation, and this is simplest and probably most accurate when one of the TSC hazard indexes is used. In this case, one simply forms C_1e^{2h}, where h = HI, the hazard index given by the desired formula chosen from the following group in Appendix B:

1. Crossbucks-comprehensive: B.5.1.3.
2. Crossbucks-volume-only: B.5.1.2.
3. Flashing lights-comprehensive: B.5.2.2.
4. Flashing lights-volume-only: B.5.2.1.
5. Automatic gates-comprehensive: B.5.3.2.

6. Automatic gates-volume-only: B.5.2.1.
If an absolute hazard function involving the New Hampshire formula is desired, the transformation is discussed in Subsection 2.3.2, but, as already noted, when an absolute hazard function is to be used, a TSC form is probably best.

Once a portion of the crossings has been chosen as the most hazardous, some measure of the expected effectiveness of the procedure may be desired. As noted throughout this report (see especially Section 2.1), the EOC and the power factor are the recommended measures of performance. Thus, if 15 percent of the crossings have been chosen using the TSC comprehensive crossbucks formula, than, as has been seen, on a national basis (see Table C-2) 51.3 percent of the accidents will occur at these crossings, giving a power factor of 3.42.

Now, if the formula is used in a certain locality, say a certain state, it is to be expected that various relationships that are observed nationally may, to some extent, not hold true. Logically, one would expect that the <u>most invariant</u> quality of a hazard index would be its general goodness as a relative hazard index -- not necessarily the specific measures of this quality of performance, but the fact that it is a good relative hazard index when compared with the performance of other hazard indexes. Next in variability would be its quality as an absolute hazard index, which might be a little more variable. Following in variability the plain absolute hazard index, which is, by definition, only <u>proportional</u> to expected accident frequency, would be the expected accident frequency itself, which might require further scaling. Last, and most variable, would be the EOC curve itself -- the power factors, etc. This would be more variable, because it would reflect local variability in the crossing characteristics themselves, not just the relation of these characteristics to accident frequency. Thus, if 15 percent of a local population of crossings is chosen according to the TSC comprehensive crossbucks model, it can be expected that a statistical deviation from the national average, 51.3 percent of the accidents in that local population, will occur at those crossings.

If one refers to Table C-2, one sees that the value of HI for the 15 percent most hazardous crossings nationally is greater than, or equal to, -0.8585, which represents the HI of the least hazardous crossings of the 15-percent chosen as the most hazardous. The least hazardous crossing of the 15 percent of the crossings chosen locally could be greater than, or less than, this value. It is suggested here that the nationally determined power factor for the actual hazard index of the least hazardous crossing in the set chosen should be used for reference to the EOC tables rather than the percentage of the local population selected for the hazardous crossings group.

By way of illustration, it is assumed that 15 percent of the crossbuck crossings have been selected using the TSC crossbucks comprehensive formula, and that the hazard index of the least hazardous crossing in the 15-percent group is HI = - 079 (from equation B.5.1.3). This HI is then referred to Table C-2 (first multiplying by 10,000 as noted in paragraph C.3 of Appendix C), and it is seen that -7900 corresponds to the national 12.5 percent point, that is, to a power factor of 3.67 rather than to the 15-percent power factor of 3.4. This small difference in power factor is not very significant, and statistical fluctuation will probably be larger. When the local estimate is close to the national average, confidence in calculation based on national statistics may have been increased.

The practical significance of a power factor of 3.6 for 15 percent of the crossings selected can be explained as follows. If all accidents at those selected crossbuck crossings could be prevented, in this hypothetical case 15 percent of all local crossbuck crossings, 54 percent of all local crossbuck crossing accidents could be prevented.

When the formulas and tables of this report are used on a national basis, they are most reliable. It is in just such circumstances that expected accident frequency based on objective crossing characteristics may be most useful in large-scale cost/benefit analyses.

APPENDIX A

THE LOGISTIC DISCRIMINANT APPROACH TO HAZARD INDEX CONSTRUCTION

First, an ordinary linear regression is run, identical to the one described in Section 2.2 except for the trivial difference that an accident is represented by +1 while a non-accident crossing is represented by -1. (In Section 2 the non-accident crossing was represented by 0.) The effect on the hazard index generated is to multiply the previous linear regression hazard index by 2 and subtract 1. That is, the present procedure produces the same hazard function except for this multiplication and subtraction. This difference is immaterial, as the hazard index so generated at this point is good as a relative hazard index only. An interative procedure is then used to find the b_k's as follows:

One should recall that $X_{i,k}$ is the kth characteristic for the ith crossing. Thus, letting C = AADT or average daily vehicle traffic, $X_{i,k} = \log (C_i)$ would be a possibility. Equation $X_{i,k} = \log T_i$, where T_i is the average number of trains at crossing i, would be another possibility.

Several variables of this type are carried in the regression. The iteration is of the so called "fixed point" or "implicit equation" type, with each step in the iteration being the equivalent of an ordinary regression. At each step, s, of the iteration, there is an estimate of b_k; k = 1, K denoted by $b_k^{(s)}$. From $b_k^{(s)}$, $h_i^{(s)}$ is defined as:

$$h_i^{(s)} = \sum_k b_k^{(s)} X_{i,k}.$$

The variables $X_{i,k}$ and Y_i undergo a nonlinear transformation before the next regression is performed:

$$x_{i,k}^{(s)} = X_{i,k} \sqrt{U(h_i)^{(s)}}$$

$$y_i^{(s)} = Y_i \sqrt{V(h_i)^{(s)}}$$

where:

$$U(h) = \operatorname{sech}^2 (h) \left(\frac{\tanh (h)}{h} \right)$$

$$V(h) = \operatorname{sech}^2 (h) \left(\frac{h}{\tanh (h)} \right)$$

The regression seeks an ordinary least squares solution to:

$$\hat{y}_i^{(s)} = \sum_{k=1}^{k} b_k^{(s+1)} x_{i,k}^{(s)}$$

The least squares solution $b_k^{(s+1)}$ is the one which minimizes $\sum_i (\hat{y}_i^{(s)} - y_i^{(s)})^2$. The regression is carried out by an ordinary linear least squares package (the IBM SSP stepwise regression package was used on a DEC PDP-10) which has been modified slightly (one or two statements) so that it does not automatically correct for the mean. This is because for this type of iterated non-linear procedure the constant term must be handled separately and explicitly; thus, $X_{i,1} = 1$ is always used. One of the basic variables must be a constant 1 (unity) with no loss of generality. (See CMR for further details.)

In this manner, $b_k^{(s)}$ leads to $b_k^{(s+1)}$; as noted already, $b_k^{(1)}$ is obtained from straight regression (no weights) which is, in effect, the same as taking $b_i^{(0)} = 0$. This will result in $h_i^{(0)} = 0$, $U[h_i^{(0)}] = 1$, and $V[h_i^{(0)}] = 1$ for all i and therefore, as stated an ordinary untransformed, unweighted linear regression.

Classical logistic discriminant analysis (Reference 6) can be shown (see CMR) to be equivalent to this procedure with U(h) and V(h) replaced by

$$U(h) = h/\tanh(h)$$

and

$$V(h) = \tanh(h)/h.$$

The functions $[\mathrm{sech}(h)]^2.h/\tanh(h)$, $[\mathrm{sech}(h)]^2.\tan(h)/h$, $h/\tanh(h)$, and $\tanh(h)/h$ are all plotted in Figures A-1 and A-2 with

$$H(h = \frac{1}{2} + \frac{1}{2} \tanh(h) = \frac{1}{1 + e^{-2h}}$$

superimposed for reference. The classical procedure may be seen to give exceptionally heavy weight (by the factor $h/\tanh(h)$ to accident crossings for which a very low accident probability is estimated ($h \to \infty$). In this case all low probability crossings are weighed low [by the factor $\mathrm{sech}^2(h)$] and only those crossings for which $H(T)$ takes intermediate values are weighed high. (The intermediate values are, relativley speaking, the high hazard values.)

It is arranged that all accident probabilities fall below 1/2. This is not required of all crossings, but of all but the 1/2 percent most hazardous. This is achieved by balancing the sample with the correct number of accidents and non-accidents, and by the use of a separate constant weighing factor for accidents in some warning device classes. The reason for having all accident probabilities fall below 1/2 (they are later scaled to their real values) is that the weighting factor $\mathrm{sech}^2(h)$ will then always be smaller for smaller $H(h)$, i.e., smaller accident probability. This is because $H(h) = 1/2$ and $\mathrm{sech}^2(h)$ takes its maximum when $h = 0$, while $H(h)$ is less than 1/2 for negative values of h. Later, when the EOC curves for specific hazard functions are presented, the effect of the factor $\mathrm{sech}^2(h)$ will be shown; this distinguishes the TSC technique from classical logistic discriminant analysis. As just noted, the effect is to emphasize the

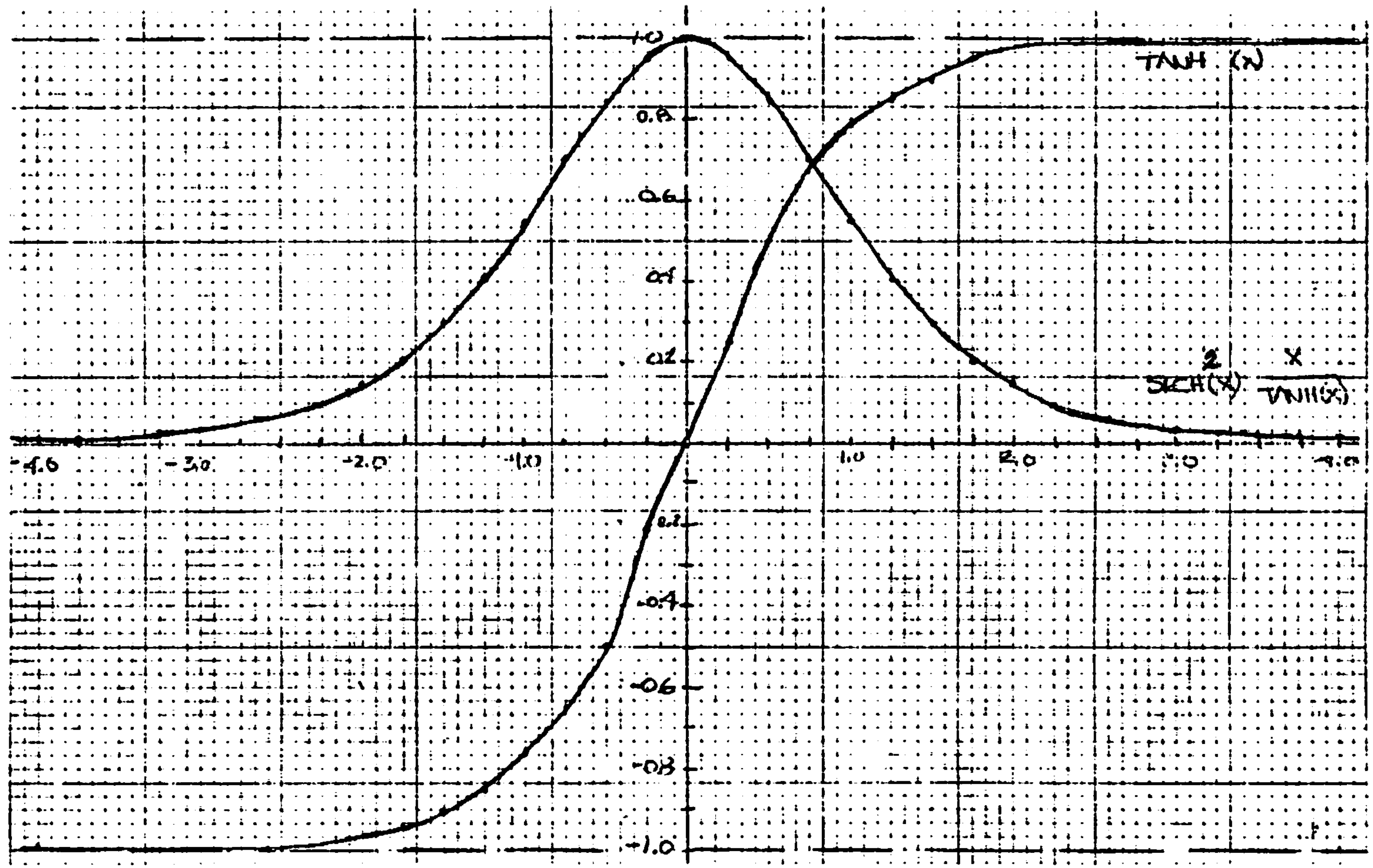


FIGURE A-1. $\operatorname{sech}^2(x) \frac{x}{\tanh(x)}$ AND $\tanh(x)$ VERSUS x

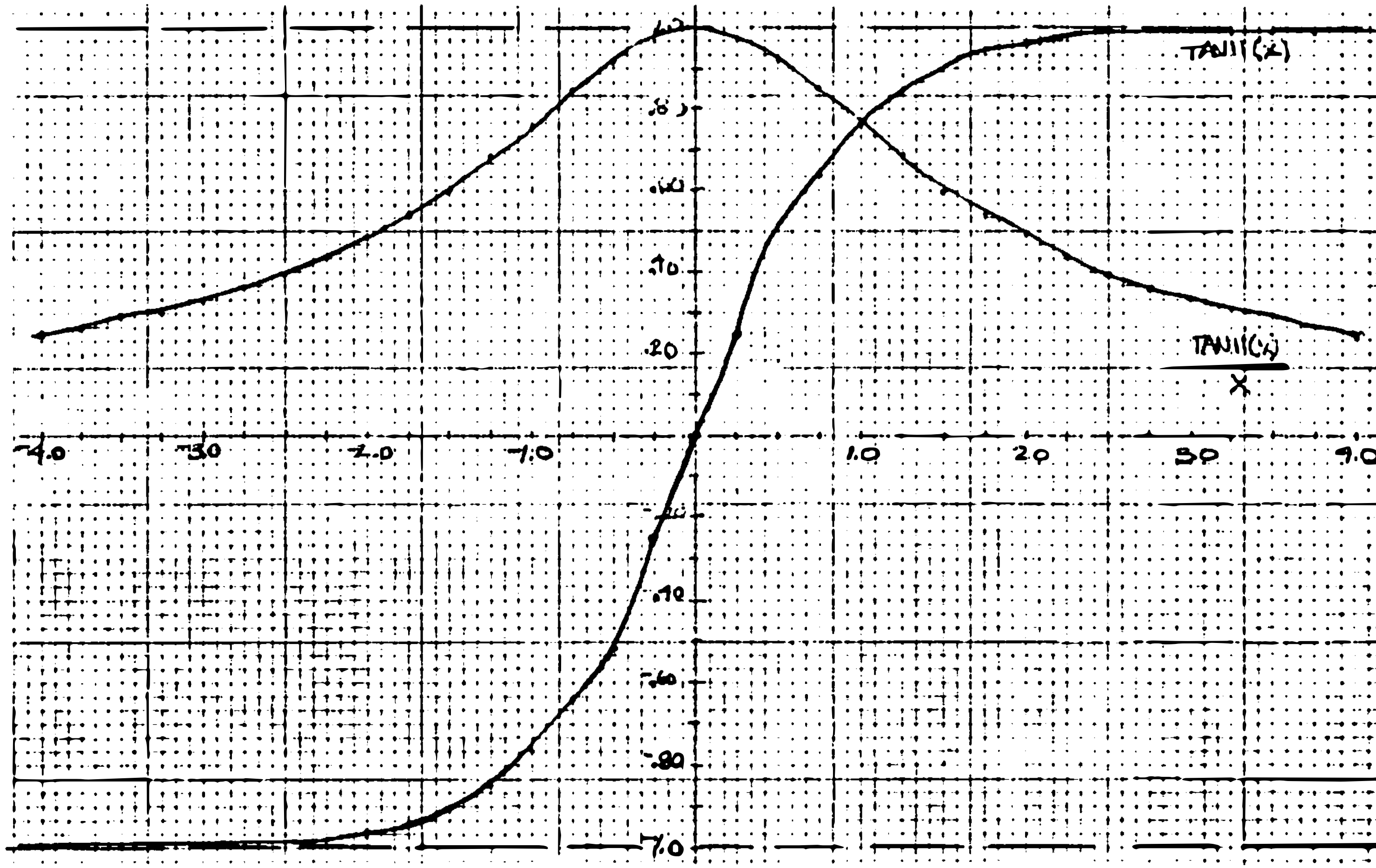


FIGURE A-2. tanh (x) and tanh $\frac{(x)}{x}$ vs. x performance of the hazard index for high hazard crossings; just how much will be shown when the results are presented.

APPENDIX B

HAZARD INDEX FORMULAS-DEFINITIONS FOR REFERENCE

B.1 COLEMAN-STEWART MODEL

$$\log_{10}A = C_o + C_1\log_{10}C + C_2\log_{10}T + C_3(\log_{10}T)^2$$

where

A = number of accidents (proportional to f)

C = average daily vehicular movements. (If C=0, use 1/2 instead for this model only.)

T = average daily train movements. (If T=0, use 1/2 instead for this model only.)

Category	C_o	C_1	C_2	C_3
Single-track urban				
Automatic gates	-2.17	0.16	0.96	-0.35
Flashing lights	-2.85	0.37	1.16	-0.42
Crossbucks	-2.38	0.26	0.78	-0.18
Single-track rural				
Automatic gates	-1.42	0.08	-0.15	-0.25
Flashing lights	-3.56	0.62	0.92	-0.38
Crossbucks	-2.77	0.40	0.89	-0.29
Multiple-track urban				
Automatic gates	-2.58	0.23	1.30	-0.42
Flashing lights	-2.50	0.36	0.68	-0.09
Crossbucks	-2.49	0.32	0.63	-0.02
Multiple-track rural				
Automatic gates	-1.63	0.22	-0.17	0.05
Flashing lights	-2.75	0.38	1.02	-0.36
Crossbucks	-2.39	0.46	-0.50	0.53

B.2 NEW HAMPSHIRE MODEL*

$$HI = T \times C$$ for Crossbucks, Flashing Lights, Gates

Where: T = train movements
C = vehicle movements
HI = hazard index

B.3 PEABODY-DIMMICK MODEL*

$$HI = C^{.170} \cdot T^{.151}$$ for Crossbucks, Flashing Lights, Gates

Where: T = train movements
C = vehicle movements
HI = hazard index

B.4 TSC LINEAR MODELS (CROSSBUCKS ONLY)

B.4.1 Car-Train Equation (Linear)

$$
\begin{aligned}
HI = & -0.02022 \\
& +0.01509 \ LOG_{10}\ (C+1)\ LOG_{10}\ (T+1) \\
& +0.01391 \ [LOG_{10}\ (C+1)]^2 \\
& +0.06330 \ LOG_{10}\ (C+1)\ LOG_{10}\ (DT+1) \\
& -0.11039 \ LOG_{10}\ (DT+1) \\
& +0.03907 \ LOG_{10}\ (NITE+1)
\end{aligned}
$$

Where: T = train novements
C = vehicle movements
DT = day thru trains
NITE = night trains
HI = hazard index

---

*Note: Original versions of these models had additive and/or multiplicative terms, depending on warning device class. Since these formulas are used only as relative hazard indexes and on only one warning device class at a time, the extra factors and terms are irrelevant. Also, the Peabody-Dimmick formula as originally given was a complex function of the formula given here, but if it is to be evaluated (or to be used) as a relative hazard index, the functional transformation becomes irrelevant (see Subsection 4.1.5).

B.4.2 Model 8C

HI = 0.11074
+1.43432 (VOL)
-0.48848 (VOL x NRBY XING HWY)
+0.07906 (VOL x POP)
+0.01996 (MAIN TRACKS)
-0.00001 (AADT/LANES+1)
-0.01349 (FC)
-0.01283 (NRBY XING HWY)
-0.01232 LOG_{10} (AADT+1)

Where:

VOL = Volume equation (HI from B.4.1)
NRBY XING HWY = nearby crossing highway?
POP = population; the tens digit of functional classification of road over crossing
MAIN TRACKS = number of main tracks
AADT = vehicle movements
LANES = number of traffic lanes
FC = the units digit of functional classification of road over crossing
HI = hazard index

B.4.3 Model 8D

HI = 3.67821
+0.75952 (VOL/NRBY XING HWY)
+0.06678 (VOL x POP)
-0.00194 ($AADT^2$/LANES)
-0.01327 (FC)
+6.80342 LOG_{10} (VOL^2)
-6.63985 $(VOL)^2$
-0.01282 (NRBY XING HWY)
-0.11629 (VOL x NRBY XING HWY)

Where:

VOL = volume equation (HI from B.4.1)

NRBY XING HWY = nearby crossing highway?

POP = population; the tens digit of functional classification of road over crossing

AADT = vehicle movements

LANES = number of traffic lanes

FC = the units digit of functional classification of road over crossing

HI = hazard index

B.5 TSC BEST NONLINEAR (LOGISTIC)

B.5.1 Crossbucks

B.5.1.1 Best Volume Model-Crossbucks

$$
\begin{aligned}
h = & -3.0264 \\
& +1.1580 \, \mathrm{LOG}_{10} \, (T+1) \\
& +0.48654 \, \mathrm{LOG}_{10} \, (C+1) \\
& -0.22122 \, [\mathrm{LOG}_{10} \, (T+1)]^2
\end{aligned}
$$

T = train movements (Sum of inventory items 24-30, Table F-2)

C = vehicle movements (Inventory item 81, Table F-2)

B.5.1.2 Refined Volume Model-Crossbucks

$$
\begin{aligned}
HI = & -0.13711 \\
& +0.38069 \; h \\
& -0.66800 \; h^2 \\
& -0.19171 \; h^3
\end{aligned}
$$

Where:

h = best volume model for crossbucks given in B.5.1.1

HI = hazard index

B.5.1.3 Comprehensive Model-Crossbucks

$$\begin{aligned} HI = & \ 0.74982 \ \text{HVOL} \\ & +0.19474 \ \text{LOG}_{10} \ (\text{DT}+1) \\ & +0.17491 \ \text{MAIN TRACKS} \\ & +0.17780 \ \text{HWY PAVED} \\ & +0.045405 \ \text{POP} \\ & -0.13139 \ \text{FC} \end{aligned}$$

Where:

HVOL = the refined volume equation for crossbucks given in B.5.1.2

DT = number of day thru trains

MAIN TRACKS = number of main tracks

HWY PAVED = is highway paved? (No = 0, Yes = 1, Note difference in coding from item 67, Table F-2

POP = population; the tens digit of functional classification of road over crossing

FC = the units digit of functional classification of road over crossing

HI = hazard index -- this is "h" in Sections 2 and 4. C_1e^{2h} is an absolute hazard index, see Subsection 2.3.1. In the tables of Appendix C, HI is multiplied by 10^4.

B.5.2 Flashing Lights

B.5.2.1 Best Volume Model-Flashing Lights

$$\begin{aligned} HI = & -2.8395 \\ & +0.75477 \ \text{LOG}_{10} \ (T+1) \\ & +0.083292 \ [\text{LOG}_{10}(C+1)]^2 \end{aligned}$$

Where:

T = train movements

C = vehicle movements

HI = hazard index

B.5.2.2 Comprehensive Model-Flashing Lights

$$
\begin{aligned}
HI = {} & 1.0422 \quad HVOL \\
& +0.13737 \quad MAIN\ TRACKS \\
& -0.097584 \quad [LOG_{10}(T+1)]^2 \\
& +0.018064 \quad LANES \\
& -0.036259 \quad FC \\
& +0.12137 \quad LOG_{10}\ (DT+1) \\
& +0.018944 \quad POP
\end{aligned}
$$

Where:

HVOL = the best volume equation for flashing lights as given in B.5.2.1

MAIN TRACKS = number of main tracks

T = train movements

LANES = number of traffic lanes

FC = the units digit of functional classification of road over crossing

DT = number of day thru trains

POP = population; the tens digit of functional classification of road over crossing

HI = hazard index -- "h" (see B.5.1.3)

B.5.3 Automatic Gates

B.5.3.1 Best Volume Model-Gates

$$
\begin{aligned}
HI = {} & -1.9674 \\
& +0.18621\ LOG_{10}\ (T+1)\ LOG_{10}\ (C+1)
\end{aligned}
$$

Where:

T = train movements

C = vehicle movements

HI = hazard index

B.5.3.2 Comprehensive Model-Gates

$$HI = -0.83656 + 0.74849\ HVOL + 0.19139\ TRACKS + 0.093829\ LANES$$

where

HVOL = best volume model for gates as given in B.5.3.1

TRACKS = number of main tracks

LANES = number of traffic lanes

HI = hazard index -- "h" (see B.5.1.3)

B.6 TSC GRADE CROSSING HAZARD MODELS (Consolidated for Easy Reference)

The formulas in this section are essentially those in B.5 repeated. They are presented in a form more convenient to use. In addition, the overall factor for each formula has been changed slightly, reflecting the normalization appropriate for using the formulas for all warning device classes. (This overall factor was referred to as C_1 in B.5 and Section 2.3.1, and is now changed to the values indicated below in the expression for H, i.e., 0.389, 1.084, and 0.820. Note that the hazard indexes here are of the form $H=ce^{2h}$, where h is an HI from B.5.)

The models to be used for Warning Device Classes 1,2,3 and 4, are:

Comprehensive Model: $H=0.389\ EXP^{2X_1}$

Volume Model: $H=0.389\ EXP^{2HVOL_1}$

where

$$X_1=0.74982 HVOL_1+0.19474\ LOG_{10}(DT+1) + 0.17491\ MAIN\ TRACKS + 0.17780\ HWY\ PAVED + 0.045405\ POP - 0.13139\ FC$$

$$HVOL_1= -0.13711+0.38069h_1-0.66800h_1{}^2 -0.19171h_1{}^3$$

$$h_1= -3.0264 + 1.1580\ LOG_{10}(T+1) +0.48654\ LOG_{10}(C+1) -0.22122 [LOG_{10}(T+1)]^2.$$

The models to be used for Warning Device Classes 5, 6 and 7 are:

Comprehensive Model: $H=1.084\ EXP^{2X_2}$

Volume Model: $H=1.084\ EXP^{2HVOL_2}$

where

$X_2=1.0422HVOL_2 + 0.13737\ \text{MAIN TRACKS} -0.097584\ [LOG_{10}(T+1)]^2$

$+0.018064\ \text{LANES} -0.036259\ FC +0.12137\ LOG_{10}(DT+1)$

$+0.018944\ POP$

$HVOL_2= -2.8395 +0.75477\ LOG_{10}(T+1) +0.083292\ [LOG_{10}(C+1)]^2.$

The models to be used for Warning Device Class 8 are:

Comprehensive Model: $H=0.820\ EXP^{2X_3}$

Volume Model: $H=0.820\ EXP^{2HVOL_3}$

where

$X_3= -0.83656 +0.74849\ HVOL_3 +0.19139\ \text{MAIN TRACKS}$

$+0.093829\ \text{LANES}$

$HVOL_3= -1.9674 +0.18621\ LOG_{10}(T+1)\ LOG_{10}(C+1).$

Explanation of symbols:

H = Expected number of accidents per year
T = Number of trains per day
C = Number of cars per day
DT = Number of day thru trains per day
MAIN TRACKS = Number of main tracks
HWY Paved = 1 if highway paved, 0 if not paved
POP = Population. This is the tens digit of functional classification of road over crossing.
FC = The units digit of functional classification of road over crossing
LANES = Number of traffic lanes
EXP = 2.71828....

Warning Device Class 8 = Automatic Gates
7 = Flashing LIght
6 = Highway Signals, Wigwags, or Bells
5 = Special Protection
4 = Crossbucks
3 = Stop Signs
2 = Cther Signs
1 = None

APPENDIX C

EOC AND POWER FACTOR TABLES

C.1 BRIEF EXPLANATION OF EOC TABLES

Most of the tables in this appendix are in the format of Table C-1. The information on the first page of the table is also described in Section 2.1. The columns are numbered along the bottom of the first page. Column 1 is labeled "%Xings", and should be interpreted as a percentage of the total crossings selected by the hazard index. Column 4 is labeled "% ACC", and gives the percent of accidents accumulated with the percent of crossings (for the TSC model), while column 3 labeled "CUM#ACC", gives the actual number of accidents with hazard index as great or greater than the value in column 6 ("HAZARD INDEX") in the data base used. Column 5, "POWER FACTOR", is the ratio of column 4 to column 1, i.e., the ratio of the cumulative percent of accidents to the cumulative percent of crossings. Thus, columns 1, 4, 5, and 6 can be interpreted without reference to a particular data base, and although they are calculated in a specific data base, they estimate the corresponding quantities with reference to all (crossbuck) crossings and all (crossbuck) accidents (at public crossings in the entire U.S.). Columns 1, 9, 10, and 11 give the same information for the New Hampshire formula, while column 20 gives the difference in percent accidents for the two formulas. The other columns (described in Section 2.1) refer mostly to the particular data base used, and can be used for calculating the accuracy and statistical significance of the results. Since, for the TSC model, 10 percent of the crossings correspond to 769 accidents, the 10 percent power factor has a relative standard error of $\frac{\sqrt{769}}{769}$ = .036 or 3.6 percent. This is reflected by the 4 percent in Table 4-1 opposite 10 percent of the crossings. Other accuracy and significance information can be derived from these columns -- especially from the t value in the last column (see Section 2.1).

C.2 LIST OF TABLES IN APPENDIX C (EOC'S AND POWER FACTORS)

C.3 LEGEND

This section identifies formulas from Appendix B used to provide data listed under the column heading HAZARD INDEX, column 6 of Tables C-1 through C-6. In each table, HAZARD INDEX is determined by the expression HIx10,000, where HI is given in the designated subsections of Appendix B as listed below for the respective tables.

Table	TSC Subsection
C-1	B.5.1.1
C-2	B.5.1.3
C-3	B.5.2.1
C-4	B.5.2.2
C-5	B.5.3.1
C-6	B.5.3.2

TABLE C-1. TSC (VOLUME ONLY) VERSUS NEW HAMPSHIRE CROSSBUCKS

·XBKVL DAT

%	TSC MODEL					* NEW HAMPSHIRE CT									TSC		NH			
Xing	INC ACC	CUM #ACC	% ACC	POWER FACTR	HAZARD INDEX	INC ACC	CUM #ACC	% ACC	POWER FACTR	HAZARD INDEX	WITH MATCH %DIFF	TVAL	INC MTCH	CUM MTCH	LESS #ACC	MATCH % ACC	LESS #ACC	MATCH % ACC	LESS MATCH %DIFF	TVAL
0.50	86	86	4.33	8.67	-2274	83	83	4.18	8.37	72000	0.15	0.2	81	81	5	0.25	2	0.10	0.15	1.1
1.00	58	144	7.26	7.26	-2941	52	135	6.80	6.80	47300	0.45	0.5	47	128	16	0.81	7	0.35	0.45	1.9
1.50	45	189	9.53	6.35	-3404	54	189	9.53	6.35	34500	0.00	0.0	46	174	15	0.76	15	0.76	0.00	0.0
2.00	65	254	12.80	6.40	-3864	56	245	12.35	6.17	27200	0.45	0.4	48	222	32	1.61	23	1.16	0.45	1.2
2.50	47	301	15.17	6.07	-4221	56	301	15.17	6.07	22800	0.00	0.0	57	279	22	1.11	22	1.11	0.00	0.0
3.00	47	348	17.54	5.85	-4561	40	341	17.19	5.73	19200	0.35	0.3	38	317	31	1.56	24	1.21	0.35	0.9
3.50	50	398	20.06	5.73	-4843	34	375	18.90	5.40	16800	1.16	0.8	37	354	44	2.22	21	1.06	1.16	2.9
4.00	31	429	21.62	5.41	-5096	41	416	20.97	5.24	14800	0.66	0.4	32	386	43	2.17	30	1.51	0.66	1.5
4.50	47	476	23.99	5.33	-5330	45	461	23.24	5.16	13000	0.76	0.5	45	431	45	2.27	30	1.51	0.76	1.7
5.00	38	514	25.91	5.18	-5546	33	494	24.90	4.98	12000	1.01	0.6	38	469	45	2.27	25	1.26	1.01	2.4
5.50	43	557	28.07	5.10	-5767	31	525	26.46	4.81	11000	1.61	1.0	31	500	57	2.87	25	1.26	1.61	3.5
6.00	25	582	29.33	4.89	-5946	42	567	28.58	4.76	10000	0.76	0.4	33	533	49	2.47	34	1.71	0.76	1.6
6.50	31	613	30.90	4.75	-6135	24	591	29.79	4.58	9150	1.11	0.6	35	568	45	2.27	23	1.16	1.11	2.7
7.00	26	639	32.21	4.60	-6275	24	615	31.00	4.43	8500	1.21	0.7	27	595	44	2.22	20	1.01	1.21	3.0
7.50	12	651	32.81	4.38	-6436	23	638	32.16	4.29	8000	0.66	0.4	15	610	41	2.07	28	1.41	0.66	1.6
8.00	21	672	33.87	4.23	-6603	27	665	33.52	4.19	7484	0.35	0.2	21	631	41	2.07	34	1.71	0.35	0.8
8.50	24	696	35.08	4.13	-6765	23	688	34.68	4.08	6900	0.40	0.2	16	647	49	2.47	41	2.07	0.40	0.8
9.00	36	732	36.90	4.10	-6906	22	710	35.79	3.98	6400	1.11	0.6	28	675	57	2.87	35	1.76	1.11	2.3
9.50	20	752	37.90	3.99	-7067	26	736	37.10	3.90	6000	0.81	0.4	19	694	58	2.92	42	2.12	0.81	1.6
10.00	17	769	38.76	3.88	-7198	23	759	38.26	3.83	5600	0.50	0.3	22	716	53	2.67	43	2.17	0.50	1.0
10.50	27	796	40.12	3.82	-7368	31	790	39.82	3.79	5250	0.30	0.2	26	742	54	2.72	48	2.42	0.30	0.6
11.00	21	817	41.18	3.74	-7490	27	817	41.18	3.74	5000	0.00	0.0	28	770	47	2.37	47	2.37	0.00	0.0
11.50	28	845	42.59	3.70	-7647	22	839	42.29	3.68	4800	0.30	0.1	25	795	50	2.52	44	2.22	0.30	0.6
12.00	28	673	44.00	3.67	-7764	30	869	43.80	3.65	4400	0.20	0.1	29	824	49	2.47	45	2.27	0.20	0.4
12.50	25	898	45.26	3.62	-7886	22	891	44.91	3.59	4200	0.35	0.2	25	849	49	2.47	42	2.12	0.35	0.7
13.00	18	916	46.17	3.55	-8001	36	927	46.72	3.59	4000	-0.55	-0.3	28	877	39	1.97	50	2.52	-0.55	-1.2
13.50	25	941	47.43	3.51	-8183	13	940	47.38	3.51	3800	0.05	0.0	17	894	47	2.37	46	2.32	0.05	0.1
14.00	6	947	47.73	3.41	-8274	17	957	48.24	3.45	3600	-0.50	-0.2	9	903	44	2.22	54	2.72	-0.50	-1.0
14.50	22	969	48.84	3.37	-8395	8	965	48.64	3.35	3500	0.20	0.1	19	922	47	2.37	43	2.17	0.20	0.4
15.00	14	983	49.55	3.30	-8480	23	988	49.80	3.32	3240	-0.25	-0.1	15	937	46	2.32	51	2.57	-0.25	-0.5
15.50	21	1004	50.60	3.26	-8628	15	1003	50.55	3.26	3070	0.05	0.0	19	956	48	2.42	47	2.37	0.05	0.1
16.00	15	1019	51.36	3.21	-8723	31	1034	52.12	3.26	3000	-0.76	-0.3	29	985	34	1.71	49	2.47	-0.76	-1.6
16.50	10	1029	51.86	3.14	-8758	1	1035	52.17	3.16	2948	-0.30	-0.1	1	986	43	2.17	49	2.47	-0.30	-0.6
17.00	24	1053	53.07	3.12	-8906	19	1054	53.13	3.13	2800	-0.05	-0.0	24	1010	43	2.17	44	2.22	-0.05	-0.1
17.50	12	1065	53.68	3.07	-9000	21	1075	54.18	3.10	2600	-0.50	-0.2	10	1020	45	2.27	55	2.77	-0.50	-1.0
18.00	26	1091	54.99	3.05	-9101	15	1090	54.94	3.05	2500	0.05	0.0	26	1046	45	2.27	44	2.22	0.05	0.1
18.50	24	1115	56.20	3.04	-9250	23	1113	56.10	3.03	2400	0.10	0.0	20	1066	49	2.47	47	2.37	0.10	0.2
19.00	19	1134	57.16	3.01	-9329	0	1113	56.10	2.95	2400	1.06	0.4	7	1073	61	3.07	40	2.02	1.06	2.1
19.50	12	1146	57.76	2.96	-9432	17	1130	56.96	2.92	2240	0.81	0.3	16	1089	57	2.87	41	2.07	0.81	1.6
20.00	18	1164	58.67	2.93	-9511	12	1142	57.56	2.88	2130	1.11	0.5	11	1100	64	3.23	42	2.12	1.11	2.1
20.50	20	1184	59.68	2.91	-9633	45	1187	59.83	2.92	2000	-0.15	-0.1	40	1140	44	2.22	47	2.37	-0.15	-0.3
21.00	8	1192	60.08	2.86	-9727	0	1187	59.83	2.85	2000	0.25	0.1	5	1145	47	2.37	42	2.12	0.25	0.5
21.50	11	1203	60.64	2.82	-9865	0	1187	59.83	2.78	2000	0.81	0.3	8	1153	50	2.52	34	1.71	0.81	1.7
22.00	13	1216	61.29	2.79	-9939	8	1195	60.23	2.74	1900	1.06	0.4	7	1160	56	2.82	35	1.76	1.06	2.2
22.50	16	1232	62.10	2.76	-10017	22	1217	61.34	2.73	1800	0.76	0.3	21	1181	51	2.57	36	1.81	0.76	1.6
23.00	7	1239	62.45	2.72	-10089	11	1228	61.90	2.69	1750	0.55	0.2	16	1197	42	2.12	31	1.56	0.55	1.3
23.50	11	1250	63.00	2.68	-10237	14	1242	62.60	2.66	1620	0.40	0.2	18	1215	35	1.76	27	1.36	0.40	1.0
24.00	10	1260	63.51	2.65	-10327	18	1260	63.51	2.65	1600	0.00	0.0	8	1223	37	1.86	37	1.86	0.00	0.0
24.50	22	1282	64.62	2.64	-10384	10	1270	64.01	2.61	1520	0.60	0.2	7	1230	52	2.62	40	2.02	0.60	1.3
25.00	15	1297	65.37	2.61	-10503	25	1295	65.27	2.61	1500	0.10	0.0	23	1253	44	2.22	42	2.12	0.10	0.2
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21 Coll.

* See LEGEND, Section C.3 (Hazard Index = hx10,000)

TABLE C-1. (cont.)

Xing	TSC MODEL INC ACC	TSC MODEL CUM #ACC	TSC MODEL % ACC	TSC MODEL POWER FACTR	TSC MODEL HAZARD INDEX	* NEW HAMPSHIRE INC ACC	NEW HAMPSHIRE CUM #ACC	NEW HAMPSHIRE % ACC	NEW HAMPSHIRE POWER FACTR	CT HAZARD INDEX	WITH MATCH %DIFF	WITH MATCH TVAL	INC MTCH	CUM MTCH	TSC LESS #ACC	TSC MATCH % ACC	NH LESS #ACC	NH MATCH % ACC	XBKVL DAT LESS MATCH %DIFF	XBKVL DAT LESS MATCH TVAL
25.50	9	1306	65.83	2.58	-10607	1	1296	65.32	2.56	1460	0.50	0.2	3	1256	50	2.52	40	2.02	0.50	1.1
26.00	21	1327	66.89	2.57	-10668	15	1311	66.08	2.54	1400	0.81	0.3	19	1275	52	2.62	36	1.81	0.81	1.7
26.50	9	1336	67.34	2.54	-10695	6	1317	66.38	2.50	1350	0.96	0.4	11	1286	50	2.52	31	1.56	0.96	2.1
27.00	10	1346	67.84	2.51	-10819	9	1326	66.83	2.48	1280	1.01	0.4	10	1296	50	2.52	30	1.51	1.01	2.2
27.50	7	1353	68.20	2.48	-10918	8	1334	67.24	2.45	1220	0.96	0.4	6	1302	51	2.57	32	1.61	0.96	2.1
28.00	13	1366	68.85	2.46	-10963	30	1364	68.75	2.46	1200	0.10	0.0	26	1328	38	1.92	36	1.81	0.10	0.2
28.50	10	1376	69.35	2.43	-11059	0	1364	68.75	2.41	1200	0.60	0.2	5	1333	43	2.17	31	1.56	0.60	1.4
29.00	10	1386	69.86	2.41	-11173	13	1377	69.41	2.39	1120	0.45	0.2	6	1339	47	2.37	38	1.92	0.45	1.0
29.50	13	1399	70.51	2.39	-11267	13	1390	70.06	2.37	1080	0.45	0.2	13	1352	47	2.37	38	1.92	0.45	1.0
30.00	9	1408	70.97	2.37	-11316	11	1401	70.61	2.35	1020	0.35	0.1	14	1366	42	2.12	35	1.76	0.35	0.8
30.50	7	1415	71.32	2.34	-11390	37	1438	72.48	2.38	1000	-1.16	-0.4	14	1380	35	1.76	58	2.92	-1.16	-2.4
31.00	12	1427	71.93	2.32	-11536	0	1438	72.48	2.34	1000	-0.55	-0.2	4	1384	43	2.17	54	2.72	-0.55	-1.1
31.50	5	1432	72.18	2.29	-11615	0	1438	72.48	2.30	1000	-0.30	-0.1	1	1385	47	2.37	53	2.67	-0.30	-0.6
32.00	16	1448	72.98	2.28	-11649	19	1457	73.44	2.29	925	-0.45	-0.2	10	1395	53	2.67	62	3.13	-0.45	-0.8
32.50	19	1467	73.94	2.28	-11754	19	1476	74.40	2.29	900	-0.45	-0.2	27	1422	45	2.27	54	2.72	-0.45	-0.9
33.00	0	1467	73.94	2.24	-11754	1	1477	74.45	2.26	890	-0.50	-0.2	0	1422	45	2.27	55	2.77	-0.50	-1.0
33.50	9	1476	74.40	2.22	-11851	12	1489	75.05	2.24	880	-0.66	-0.2	8	1430	46	2.32	59	2.97	-0.66	-1.3
34.00	11	1487	74.95	2.20	-11964	27	1516	76.41	2.25	800	-1.46	-0.5	18	1448	39	1.97	68	3.43	-1.46	-2.8
34.50	14	1501	75.66	2.19	-12081	0	1516	76.41	2.21	800	-0.76	-0.3	6	1454	47	2.37	62	3.13	-0.76	-1.4
35.00	14	1515	76.36	2.18	-12158	3	1519	76.56	2.19	776	-0.20	-0.1	9	1463	52	2.62	56	2.82	-0.20	-0.4
35.50	13	1528	77.02	2.17	-12268	9	1528	77.02	2.17	750	0.00	0.0	12	1475	53	2.67	53	2.67	0.00	0.0
36.00	12	1540	77.62	2.16	-12297	17	1545	77.87	2.16	720	-0.25	-0.1	24	1499	41	2.07	46	2.32	-0.25	-0.5
36.50	17	1557	78.48	2.15	-12369	7	1552	78.23	2.14	700	0.25	0.1	18	1517	40	2.02	35	1.76	0.25	0.6
37.00	6	1563	78.78	2.13	-12488	5	1557	78.48	2.12	660	0.30	0.1	4	1521	42	2.12	36	1.81	0.30	0.7
37.50	10	1573	79.28	2.11	-12587	7	1564	78.83	2.10	640	0.45	0.2	3	1524	49	2.47	40	2.02	0.45	1.0
38.00	6	1579	79.59	2.09	-12599	37	1601	80.70	2.12	600	-1.11	-0.4	19	1543	36	1.81	58	2.92	-1.11	-2.3
38.50	10	1589	80.09	2.08	-12679	0	1601	80.70	2.10	600	-0.60	-0.2	8	1551	38	1.92	50	2.52	-0.60	-1.3
39.00	9	1598	80.54	2.07	-12763	0	1601	80.70	2.07	600	-0.15	-0.1	8	1559	39	1.97	42	2.12	-0.15	-0.3
39.50	6	1604	80.85	2.05	-12871	0	1601	80.70	2.04	594	0.15	0.1	1	1560	44	2.22	41	2.07	0.15	0.3
40.00	6	1610	81.15	2.03	-12911	11	1612	81.25	2.03	550	-0.10	-0.0	10	1570	40	2.02	42	2.12	-0.10	-0.2
40.50	5	1615	81.40	2.01	-12986	6	1618	81.55	2.01	522	-0.15	-0.1	7	1577	38	1.92	41	2.07	-0.15	-0.3
41.00	4	1619	81.60	1.99	-13048	23	1641	82.71	2.02	500	-1.11	-0.4	10	1587	32	1.61	54	2.72	-1.11	-2.4
41.50	6	1625	81.91	1.97	-13160	0	1641	82.71	1.99	500	-0.81	-0.3	2	1589	36	1.81	52	2.62	-0.81	-1.7
42.00	9	1634	82.36	1.96	-13235	0	1641	82.71	1.97	500	-0.35	-0.1	5	1594	40	2.02	47	2.37	-0.35	-0.8
42.50	4	1638	82.56	1.94	-13305	0	1641	82.71	1.95	500	-0.15	-0.1	2	1596	42	2.12	45	2.27	-0.15	-0.3
43.00	0	1638	82.56	1.92	-13347	7	1648	83.06	1.93	480	-0.50	-0.2	4	1600	38	1.92	48	2.42	-0.50	-1.1
43.50	9	1647	83.01	1.91	-13453	4	1652	83.27	1.91	460	-0.25	-0.1	8	1608	39	1.97	44	2.22	-0.25	-0.5
44.00	5	1652	83.27	1.89	-13555	9	1661	83.72	1.90	450	-0.45	-0.2	7	1615	37	1.86	46	2.32	-0.45	-1.0
[illegible]	11	1663	83.82	1.88	-13607	7	1668	84.07	1.89	420	-0.25	-0.1	14	1629	34	1.71	39	1.97	-0.25	-0.6
45.00	4	1667	84.02	1.87	-13721	23	1691	85.23	1.89	400	-1.21	-0.4	5	1634	33	1.66	57	2.87	-1.21	-2.5
45.50	8	1675	84.43	1.86	-13792	0	1691	85.23	1.87	400	-0.81	-0.3	6	1640	35	1.76	51	2.57	-0.81	-1.7
46.00	5	1680	84.68	1.84	-13861	0	1691	85.23	1.85	400	-0.55	-0.2	2	1642	38	1.92	49	2.47	-0.55	-1.2
46.50	17	1697	85.53	1.84	-13966	0	1691	85.23	1.83	400	0.30	0.1	16	1658	39	1.97	33	1.66	0.30	0.7
47.00	0	1697	85.53	1.82	-13966	1	1692	85.28	1.81	376	0.25	0.1	0	1658	39	1.97	34	1.71	0.25	0.6
47.50	13	1710	86.19	1.81	-14044	7	1699	85.64	1.80	360	0.55	0.2	17	1675	35	1.76	24	1.21	0.55	1.4
[illegible]	0	1710	86.19	1.80	-14044	0	1699	85.64	1.78	350	0.55	0.2	0	1675	35	1.76	24	1.21	0.55	1.4
48.50	1	1711	86.24	1.78	-14113	5	1704	85.89	1.77	326	0.35	0.1	3	1678	33	1.66	26	1.31	0.35	0.9
49.00	9	1719	86.64	1.77	-14216	5	1709	86.14	1.76	320	0.50	0.2	6	1684	35	1.76	25	1.26	0.50	1.3
49.50	8	1727	87.05	1.76	-14250	14	1723	86.84	1.75	300	0.20	0.1	10	1694	33	1.66	29	1.46	0.20	0.5
50.00	3	1730	87.20	1.74	-14268	0	1723	86.84	1.74	300	0.35	0.1	2	1696	34	1.71	27	1.36	0.35	0.9

*See LEGEND, Section C.3.

TABLE C-1* (cont.)
(TSC)

% Xing	PPi	CON 1	CON 2	CON 3	CON 4	% Xing	PP	CON 1	CON 2	CON 3	CON 4
0.50	8.67	3.65	1.64	0.94	0.62	25.50	2.58	3.10	1.89	0.81	0.75
1.00	7.26	3.48	1.58	0.92	0.63	26.00	2.57	3.16	1.91	0.81	0.76
1.50	6.35	3.30	1.51	0.90	0.63	26.50	2.54	3.13	1.91	0.81	0.75
2.00	6.40	3.53	1.64	0.94	0.67	27.00	2.51	3.11	1.92	0.81	0.75
2.50	6.07	3.53	1.65	0.94	0.68	27.50	2.48	3.06	1.92	0.80	0.75
3.00	5.85	3.56	1.67	0.94	0.69	28.00	2.46	3.07	1.93	0.80	0.75
3.50	5.73	3.64	1.71	0.95	0.70	28.50	2.43	3.05	1.94	0.79	0.75
4.00	5.41	3.55	1.68	0.94	0.70	29.00	2.41	3.03	1.95	0.79	0.75
4.50	5.33	3.64	1.72	0.95	0.72	29.50	2.39	3.05	1.96	0.79	0.75
5.00	5.18	3.65	1.73	0.95	0.72	30.00	2.37	3.02	1.96	0.78	0.75
5.50	5.10	3.72	1.76	0.96	0.73	30.50	2.34	2.98	1.97	0.78	0.75
6.00	4.89	3.64	1.74	0.95	0.73	31.00	2.32	2.99	1.98	0.78	0.75
6.50	4.75	3.63	1.74	0.94	0.73	31.50	2.29	2.94	1.98	0.77	0.74
7.00	4.60	3.58	1.73	0.94	0.73	32.00	2.28	2.98	2.00	0.77	0.75
7.50	4.38	3.43	1.69	0.92	0.72	32.50	2.28	3.06	2.02	0.78	0.75
8.00	4.23	3.37	1.68	0.91	0.72	33.00	2.24	2.96	2.02	0.77	0.75
8.50	4.13	3.34	1.67	0.90	0.72	33.50	2.22	2.95	2.03	0.76	0.75
9.00	4.10	3.41	1.70	0.91	0.73	34.00	2.20	2.96	2.04	0.76	0.75
9.50	3.99	3.36	1.69	0.90	0.73	34.50	2.19	3.00	2.06	0.76	0.75
10.00	3.88	3.29	1.68	0.89	0.72	35.00	2.18	3.04	2.08	0.76	0.75
10.50	3.82	3.31	1.70	0.89	0.73	35.50	2.17	3.07	2.09	0.76	0.75
11.00	3.74	3.28	1.70	0.89	0.73	36.00	2.16	3.10	2.11	0.76	0.76
11.50	3.70	3.32	1.71	0.89	0.73	36.50	2.15	3.18	2.13	0.76	0.76
12.00	3.67	3.36	1.73	0.89	0.74	37.00	2.13	3.15	2.14	0.76	0.76
12.50	3.62	3.38	1.74	0.89	0.74	37.50	2.11	3.16	2.16	0.76	0.76
13.00	3.55	3.35	1.74	0.89	0.74	38.00	2.09	3.13	2.16	0.75	0.76
13.50	3.51	3.37	1.75	0.89	0.75	38.50	2.08	3.15	2.18	0.75	0.76
14.00	3.41	3.26	1.73	0.87	0.74	39.00	2.07	3.16	2.19	0.75	0.76
14.50	3.37	3.27	1.74	0.87	0.74	39.50	2.05	3.13	2.20	0.74	0.76
15.00	3.30	3.23	1.74	0.87	0.74	40.00	2.03	3.10	2.21	0.74	0.76
15.50	3.26	3.24	1.75	0.87	0.74	40.50	2.01	3.07	2.22	0.73	0.75
16.00	3.21	3.21	1.75	0.86	0.74	41.00	1.99	3.02	2.23	0.73	0.75
16.50	3.14	3.14	1.74	0.85	0.74	41.50	1.97	3.00	2.24	0.72	0.75
17.00	3.12	3.18	1.76	0.86	0.74	42.00	1.96	3.01	2.26	0.72	0.75
17.50	3.07	3.14	1.76	0.85	0.74	42.50	1.94	2.96	2.27	0.72	0.75
18.00	3.05	3.20	1.78	0.85	0.75	43.00	1.92	2.87	2.27	0.71	0.74
18.50	3.04	3.25	1.80	0.86	0.75	43.50	1.91	2.89	2.29	0.71	0.74
19.00	3.01	3.27	1.81	0.85	0.75	44.00	1.89	2.86	2.31	0.70	0.74
19.50	2.96	3.23	1.81	0.85	0.75	44.50	1.88	2.90	2.33	0.70	0.74
20.00	2.93	3.25	1.82	0.85	0.75	45.00	1.87	2.86	2.34	0.70	0.74
20.50	2.91	3.28	1.84	0.85	0.76	45.50	1.86	2.88	2.36	0.70	0.74
21.00	2.86	3.22	1.83	0.84	0.75	46.00	1.84	2.85	2.37	0.69	0.74
21.50	2.82	3.19	1.83	0.84	0.75	46.50	1.84	2.99	2.40	0.70	0.74
22.00	2.79	3.17	1.84	0.83	0.75	47.00	1.82	2.89	2.41	0.69	0.74
22.50	2.76	3.18	1.65	0.83	0.75	47.50	1.81	2.98	2.44	0.69	0.74
23.00	2.72	3.12	1.85	0.82	0.75	48.00	1.80	2.89	2.45	0.68	0.74
23.50	2.68	3.09	1.85	0.82	0.75	48.50	1.78	2.81	2.46	0.68	0.73
24.00	2.65	3.06	1.85	0.81	0.75	49.00	1.77	2.84	2.48	0.67	0.73
24.50	2.64	3.12	1.88	0.82	0.75	49.50	1.76	2.86	2.50	0.67	0.74
25.00	2.61	3.13	1.89	0.82	0.75	50.00	1.74	2.81	2.52	0.67	0.73

*See Subsection 4.1.2 for discussion of CON 1-CON 4.

TABLE C-1 (cont.)

(NH)

% Xing	PPi	CON 1	CON 2	CON 3	CON 4
0.50	8.37	3.55	1.58	0.92	0.61
1.00	6.80	3.29	1.48	0.89	0.61
1.50	6.35	3.30	1.51	0.90	0.63
2.00	6.17	3.40	1.58	0.92	0.65
2.50	6.07	3.53	1.65	0.94	0.68
3.00	5.73	3.48	1.63	0.93	0.68
3.50	5.40	3.39	1.61	0.92	0.68
4.00	5.24	3.41	1.63	0.92	0.69
4.50	5.16	3.49	1.67	0.93	0.70
5.00	4.98	3.46	1.66	0.93	0.71
5.50	4.81	3.43	1.66	0.92	0.71
6.00	4.76	3.51	1.69	0.93	0.72
6.50	4.58	3.44	1.68	0.92	0.72
7.00	4.43	3.38	1.67	0.91	0.71
7.50	4.29	3.32	1.66	0.90	0.71
8.00	4.19	3.31	1.66	0.90	0.72
8.50	4.08	3.27	1.65	0.90	0.71
9.00	3.98	3.23	1.65	0.89	0.71
9.50	3.90	3.23	1.66	0.89	0.72
10.00	3.83	3.22	1.66	0.88	0.72
10.50	3.79	3.26	1.68	0.89	0.72
11.00	3.74	3.28	1.70	0.89	0.73
11.50	3.68	3.27	1.70	0.89	0.73
12.00	3.65	3.33	1.72	0.89	0.74
12.50	3.59	3.32	1.73	0.89	0.74
13.00	3.59	3.43	1.76	0.90	0.75
13.50	3.51	3.37	1.75	0.89	0.75
14.00	3.45	3.34	1.75	0.88	0.75
14.50	3.35	3.24	1.74	0.87	0.74
15.00	3.32	3.27	1.75	0.87	0.74
15.50	3.26	3.23	1.75	0.87	0.74
16.00	3.26	3.32	1.78	0.87	0.75
16.50	3.16	3.19	1.75	0.86	0.74
17.00	3.13	3.19	1.76	0.86	0.74
17.50	3.10	3.21	1.78	0.86	0.75
18.00	3.05	3.19	1.78	0.85	0.74
18.50	3.03	3.24	1.80	0.85	0.75
19.00	2.95	3.11	1.78	0.84	0.74
19.50	2.92	3.11	1.79	0.84	0.74
20.00	2.88	3.08	1.79	0.83	0.74
20.50	2.92	3.30	1.84	0.85	0.76
21.00	2.85	3.18	1.83	0.84	0.75
21.50	2.78	3.06	1.81	0.83	0.74
22.00	2.74	3.01	1.81	0.82	0.74
22.50	2.73	3.06	1.83	0.82	0.74
23.00	2.69	3.03	1.83	0.82	0.74
23.50	2.66	3.03	1.84	0.81	0.74
24.00	2.65	3.06	1.85	0.81	0.75
24.50	2.61	3.03	1.86	0.81	0.74
25.00	2.61	3.12	1.88	0.82	0.75

% Xing	PP	CON 1	CON 2	CON 3	CON 4
25.50	2.56	3.02	1.87	0.80	0.74
26.00	2.54	3.03	1.89	0.80	0.75
26.50	2.50	2.98	1.89	0.80	0.74
27.00	2.48	2.95	1.89	0.79	0.74
27.50	2.45	2.91	1.89	0.79	0.74
28.00	2.46	3.05	1.93	0.80	0.75
28.50	2.41	2.95	1.92	0.79	0.74
29.00	2.39	2.96	1.93	0.78	0.74
29.50	2.37	2.97	1.95	0.78	0.74
30.00	2.35	2.96	1.96	0.78	0.74
30.50	2.38	3.19	2.00	0.79	0.76
31.00	2.34	3.09	2.00	0.78	0.75
31.50	2.30	2.99	1.99	0.78	0.75
32.00	2.29	3.07	2.01	0.78	0.75
32.50	2.29	3.15	2.04	0.78	0.76
33.00	2.26	3.06	2.03	0.77	0.75
33.50	2.24	3.07	2.05	0.77	0.75
34.00	2.25	3.25	2.08	0.78	0.76
34.50	2.21	3.15	2.08	0.77	0.76
35.00	2.19	3.08	2.08	0.76	0.75
35.50	2.17	3.07	2.09	0.76	0.75
36.00	2.16	3.15	2.12	0.76	0.76
36.50	2.14	3.13	2.13	0.76	0.76
37.00	2.12	3.08	2.13	0.75	0.76
37.50	2.10	3.06	2.14	0.75	0.75
38.00	2.12	3.40	2.19	0.77	0.77
38.50	2.10	3.29	2.20	0.76	0.77
39.00	2.07	3.19	2.20	0.75	0.76
39.50	2.04	3.09	2.20	0.74	0.76
40.00	2.03	3.13	2.22	0.74	0.76
40.50	2.01	3.10	2.23	0.74	0.76
41.00	2.02	3.30	2.26	0.74	0.76
41.50	1.99	3.20	2.27	0.74	0.76
42.00	1.97	3.10	2.27	0.73	0.75
42.50	1.95	3.00	2.27	0.72	0.75
43.00	1.93	2.99	2.29	0.72	0.75
43.50	1.91	2.95	2.30	0.71	0.75
44.00	1.90	2.97	2.32	0.71	0.75
44.50	1.89	2.97	2.33	0.71	0.75
45.00	1.89	3.19	2.37	0.71	0.76
45.50	1.87	3.09	2.38	0.71	0.75
46.00	1.85	3.00	2.39	0.70	0.75
46.50	1.83	2.90	2.39	0.69	0.74
47.00	1.81	2.83	2.40	0.69	0.74
47.50	1.80	2.83	2.42	0.68	0.74
48.00	1.78	2.74	2.43	0.68	0.73
48.50	1.77	2.72	2.45	0.67	0.73
49.00	1.76	2.70	2.46	0.67	0.73
49.50	1.75	2.80	2.49	0.67	0.73
50.00	1.74	2.71	2.51	0.66	0.73

*See Subsection 4.1.2 for discussion of CON 1- CON 4.

TABLE C-2. TSC (COMPREHENSIVE) VERSUS NEW HAMPSHIRE CROSSBUCKS

% Xing	TSC MODEL INC ACC	TSC MODEL CUM #ACC	TSC MODEL % ACC	TSC MODEL POWER FACTR	TSC MODEL HAZARD INDEX	* NEW HAMPSHIRE CT INC ACC	NEW HAMPSHIRE CT CUM #ACC	NEW HAMPSHIRE CT % ACC	NEW HAMPSHIRE CT POWER FACTR	NEW HAMPSHIRE CT HAZARD INDEX	WITH BATCH %DIFF	WITH BATCH TVAL	INC BTCH	CUM BTCH	TSC LESS BATCH #ACC	TSC LESS BATCH % ACC	NH LESS BATCH #ACC	NH LESS BATCH % ACC	ZZZZZ'DAT LESS BATCH %DIFF	ZZZZZ'DAT LESS BATCH TVAL
0.50	96	96	4.84	9.68	-1095	83	83	4.18	8.37	72000	0.66	1.0	39	39	57	2.87	44	2.22	0.66	1.3
1.00	60	156	7.86	7.86	-2279	52	135	6.80	6.80	47300	1.06	1.2	38	77	79	3.98	58	2.92	1.06	1.8
1.50	38	194	9.78	6.52	-2896	54	189	9.53	6.35	34500	0.25	0.3	37	114	80	4.03	75	3.78	0.25	0.4
2.00	40	234	11.79	5.90	-3326	56	245	12.35	6.17	27200	-0.55	-0.5	35	149	85	4.28	96	4.84	-0.55	-0.8
2.50	49	283	14.26	5.71	-3800	56	301	15.17	6.07	22800	-0.91	-0.7	52	201	82	4.13	100	5.04	-0.91	-1.3
3.00	70	353	17.79	5.93	-4220	40	341	17.19	5.73	19200	0.60	0.5	46	247	106	5.34	94	4.74	0.60	0.8
3.50	41	394	19.86	5.67	-4579	34	375	18.90	5.40	16800	0.96	0.7	26	273	121	6.10	102	5.14	0.96	1.3
4.00	41	435	21.93	5.48	-4920	41	416	20.97	5.24	14800	0.96	0.7	39	312	123	6.20	104	5.24	0.96	1.3
4.50	46	481	24.24	5.39	-5212	45	461	23.24	5.16	13000	1.01	0.7	41	353	128	6.45	108	5.44	1.01	1.3
5.00	36	517	26.06	5.21	-5468	33	494	24.90	4.98	12000	1.16	0.7	32	385	132	6.65	109	5.49	1.16	1.5
5.50	34	551	27.77	5.05	-5700	31	525	26.46	4.81	11000	1.31	0.8	30	415	136	6.85	110	5.54	1.31	1.7
6.00	35	586	29.54	4.92	-5928	42	567	28.58	4.76	10000	0.96	0.6	40	455	131	6.60	112	5.65	0.96	1.2
6.50	37	623	31.40	4.83	-6152	24	591	29.79	4.58	9150	1.61	0.9	33	488	135	6.80	103	5.19	1.61	2.1
7.00	26	649	32.71	4.67	-6312	24	615	31.00	4.43	8500	1.71	1.0	33	521	128	6.45	94	4.74	1.71	2.3
7.50	44	693	34.93	4.66	-6500	23	638	32.16	4.29	8000	2.77	1.5	35	556	137	6.91	82	4.13	2.77	3.7
8.00	31	724	36.49	4.56	-6670	27	665	33.52	4.19	7484	2.97	1.6	30	586	138	6.96	79	3.98	2.97	4.0
8.50	24	748	37.70	4.44	-6840	23	688	34.68	4.08	6900	3.02	1.6	21	607	141	7.11	81	4.08	3.02	4.0
9.00	27	775	39.06	4.34	-6985	22	710	35.79	3.98	6400	3.28	1.7	25	632	143	7.21	78	3.93	3.28	4.4
9.50	23	798	40.22	4.23	-7117	26	736	37.10	3.90	6000	3.13	1.6	27	659	139	7.01	77	3.88	3.13	4.2
10.00	15	813	40.98	4.10	-7258	23	759	38.26	3.83	5600	2.72	1.4	23	682	131	6.60	77	3.88	2.72	3.7
10.50	20	833	41.99	4.00	-7391	31	790	39.82	3.79	5250	2.17	1.1	23	705	128	6.45	85	4.28	2.17	2.9
11.00	19	852	42.94	3.90	-7540	27	817	41.18	3.74	5000	1.76	0.9	19	724	128	6.45	93	4.69	1.76	2.4
11.50	22	874	44.05	3.83	-7681	22	839	42.29	3.68	4800	1.76	0.8	21	745	129	6.50	94	4.74	1.76	2.3
12.00	19	893	45.01	3.75	-7820	30	869	43.80	3.65	4400	1.21	0.6	29	774	119	6.00	95	4.79	1.21	1.6
12.50	18	911	45.92	3.67	-7956	22	891	44.91	3.59	4200	1.01	0.5	23	797	114	5.75	94	4.74	1.01	1.4
13.00	21	932	46.98	3.61	-8068	36	927	46.72	3.59	4000	0.25	0.1	26	823	109	5.49	104	5.24	0.25	0.3
13.50	21	953	48.03	3.56	-8209	13	940	47.38	3.51	3800	0.66	0.3	16	839	114	5.75	101	5.09	0.66	0.9
14.00	20	973	49.04	3.50	-8339	17	957	48.24	3.45	3600	0.81	0.4	27	866	107	5.39	91	4.59	0.81	1.1
14.50	23	996	50.20	3.46	-8458	8	965	48.64	3.35	3500	1.56	0.7	12	878	118	5.95	87	4.39	1.56	2.2
15.00	21	1017	51.26	3.42	-8585	23	988	49.80	3.32	3240	1.46	0.6	28	906	111	5.59	82	4.13	1.46	2.1
15.50	21	1038	52.32	3.38	-8724	15	1003	50.55	3.26	3070	1.76	0.8	16	922	116	5.85	81	4.08	1.76	2.5
16.00	18	1056	53.23	3.33	-8827	31	1034	52.12	3.26	3000	1.11	0.5	24	946	110	5.54	88	4.44	1.11	1.6
16.50	15	1071	53.98	3.27	-8937	1	1035	52.17	3.16	2948	1.81	0.8	12	958	113	5.70	77	3.88	1.81	2.6
17.00	20	1091	54.99	3.23	-9055	19	1054	53.13	3.13	2800	1.86	0.8	21	979	112	5.65	75	3.78	1.86	2.7
17.50	16	1107	55.80	3.19	-9154	21	1075	54.18	3.10	2600	1.61	0.7	17	996	111	5.59	79	3.98	1.61	2.3
18.00	16	1123	56.60	3.14	-9256	15	1090	54.94	3.05	2500	1.66	0.7	14	1010	113	5.70	80	4.03	1.66	2.4
18.50	23	1146	57.76	3.12	-9345	23	1113	56.10	3.03	2400	1.66	0.7	16	1026	120	6.05	87	4.39	1.66	2.3
19.00	7	1153	58.11	3.06	-9453	0	1113	56.10	2.95	2400	2.02	0.8	4	1030	123	6.20	83	4.18	2.02	2.8
19.50	23	1176	59.27	3.04	-9548	17	1130	56.96	2.92	2240	2.32	1.0	26	1056	120	6.05	74	3.73	2.32	3.3
20.00	20	1196	60.28	3.01	-9650	12	1142	57.56	2.88	2130	2.72	1.1	13	1069	127	6.40	73	3.68	2.72	3.8
20.50	13	1209	60.94	2.97	-9735	45	1187	59.83	2.92	2000	1.11	0.4	33	1102	107	5.39	85	4.28	1.11	1.6
21.00	13	1222	61.59	2.93	-9817	0	1187	59.83	2.85	2000	1.76	0.7	7	1109	113	5.70	78	3.93	1.76	2.5
21.50	11	1233	62.15	2.89	-9916	0	1187	59.83	2.78	2000	2.32	0.9	9	1118	115	5.80	69	3.48	2.32	3.4
22.00	8	1241	62.55	2.84	-10021	8	1195	60.23	2.74	1900	2.32	0.9	7	1125	116	5.85	70	3.53	2.32	3.4
22.50	18	1259	63.46	2.82	-10120	22	1217	61.34	2.73	1800	2.12	0.8	18	1143	116	5.85	74	3.73	2.12	3.0
23.00	13	1272	64.11	2.79	-10242	11	1228	61.90	2.69	1750	2.22	0.9	15	1158	114	5.75	70	3.53	2.22	3.2
23.50	19	1291	65.07	2.77	-10350	14	1242	62.60	2.66	1620	2.47	1.0	19	1177	114	5.75	65	3.28	2.47	3.7
24.00	6	1297	65.37	2.72	-10443	18	1260	63.51	2.65	1600	1.86	0.7	11	1188	109	5.49	72	3.63	1.86	2.8
24.50	15	1312	66.13	2.70	-10538	10	1270	64.01	2.61	1520	2.12	0.8	12	1200	112	5.65	70	3.53	2.12	3.1
25.00	19	1331	67.09	2.68	-10641	25	1295	65.27	2.61	1500	1.81	0.7	21	1221	110	5.54	74	3.73	1.81	2.7

* See LEGEND, Section C.3.

TABLE C-2. (cont.)

% Xing	TSC MODEL INC ACC	CUM #ACC	% ACC	POWER FACTR	HAZARD INDEX*	NEW HAMPSHIRE INC ACC	CUM #ACC	% ACC	POWER FACTR	CT HAZARD INDEX	WITH MATCH %DIFF	TVAL	INC MTCH	CUM MTCH	TSC LESS MATCH #ACC	% ACC	NH LESS MATCH #ACC	% ACC	ZZZZZ DAT LESS MATCH %DIFF	TVAL
25.50	11	1342	67.64	2.65	-10732	1	1296	65.32	2.56	1460	2.32	0.9	6	1227	115	5.80	69	3.48	2.32	3.4
26.00	7	1349	67.99	2.62	-10828	15	1311	66.08	2.54	1400	1.92	0.7	8	1235	114	5.75	76	3.83	1.92	2.8
26.50	8	1357	68.40	2.58	-10927	6	1317	66.38	2.50	1350	2.02	0.8	7	1242	115	5.80	75	3.78	2.02	2.9
27.00	10	1367	68.90	2.55	-11014	9	1326	66.83	2.48	1280	2.07	0.8	9	1251	116	5.85	75	3.78	2.07	3.0
27.50	11	1378	69.46	2.53	-11115	8	1334	67.24	2.45	1220	2.22	0.8	9	1260	118	5.95	74	3.73	2.22	3.2
28.00	12	1390	70.06	2.50	-11209	30	1364	68.75	2.46	1200	1.31	0.5	27	1287	103	5.19	77	3.88	1.31	1.9
28.50	13	1403	70.72	2.48	-11298	0	1364	68.75	2.41	1200	1.97	0.7	7	1294	109	5.49	70	3.53	1.97	2.9
29.00	7	1410	71.07	2.45	-11374	13	1377	69.41	2.39	1120	1.66	0.6	9	1303	107	5.39	74	3.73	1.66	2.5
29.50	14	1424	71.77	2.43	-11481	13	1390	70.06	2.37	1080	1.71	0.6	13	1316	108	5.44	74	3.73	1.71	2.5
30.00	10	1434	72.28	2.41	-11554	11	1401	70.61	2.35	1020	1.66	0.6	14	1330	104	5.24	71	3.58	1.66	2.5
30.50	21	1455	73.34	2.40	-11653	37	1438	72.48	2.38	1000	0.86	0.3	28	1358	97	4.89	80	4.03	0.86	1.3
31.00	6	1461	73.64	2.38	-11736	0	1438	72.48	2.34	1000	1.16	0.4	3	1361	100	5.04	77	3.88	1.16	1.7
31.50	7	1468	73.99	2.35	-11814	0	1438	72.48	2.30	1000	1.51	0.6	3	1364	104	5.24	74	3.73	1.51	2.2
32.00	16	1484	74.80	2.34	-11908	19	1457	73.44	2.29	925	1.36	0.5	25	1389	95	4.79	68	3.43	1.36	2.1
32.50	9	1493	75.25	2.32	-11986	19	1476	74.40	2.29	900	0.86	0.3	15	1404	89	4.49	72	3.63	0.86	1.3
33.00	6	1499	75.55	2.29	-12070	1	1477	74.45	2.26	890	1.11	0.4	4	1408	91	4.59	69	3.48	1.11	1.7
33.50	9	1508	76.01	2.27	-12140	12	1489	75.05	2.24	840	0.96	0.3	9	1417	91	4.59	72	3.63	0.96	1.5
34.00	14	1522	76.71	2.26	-12241	27	1516	76.41	2.25	800	0.30	0.1	17	1434	88	4.44	82	4.13	0.30	0.5
34.50	7	1529	77.07	2.23	-12300	0	1516	76.41	2.21	800	0.66	0.2	4	1438	91	4.59	78	3.93	0.66	1.0
35.00	8	1537	77.47	2.21	-12398	3	1519	76.56	2.19	776	0.91	0.3	6	1444	93	4.69	75	3.78	0.91	1.4
35.50	12	1549	78.07	2.20	-12476	9	1528	77.02	2.17	750	1.06	0.4	13	1457	92	4.64	71	3.58	1.06	1.6
36.00	14	1563	78.78	2.19	-12565	17	1545	77.87	2.16	720	0.91	0.3	21	1478	85	4.28	67	3.38	0.91	1.5
36.50	6	1569	79.08	2.17	-12632	7	1552	78.23	2.14	700	0.86	0.3	7	1485	84	4.23	67	3.38	0.86	1.4
37.00	3	1572	79.23	2.14	-12701	5	1557	78.48	2.12	660	0.76	0.3	6	1491	81	4.08	66	3.33	0.76	1.2
37.50	4	1576	79.44	2.12	-12762	7	1564	78.83	2.10	640	0.60	0.2	9	1500	76	3.83	64	3.23	0.60	1.0
38.00	9	1585	79.89	2.10	-12850	37	1601	80.70	2.12	600	-0.81	-0.3	25	1525	60	3.02	76	3.83	-0.81	-1.4
38.50	4	1589	80.09	2.08	-12928	0	1601	80.70	2.10	600	-0.60	-0.2	2	1527	62	3.13	74	3.73	-0.60	-1.0
39.00	8	1597	80.49	2.06	-13003	0	1601	80.70	2.07	600	-0.20	-0.1	4	1531	66	3.33	70	3.53	-0.20	-0.3
39.50	6	1603	80.80	2.05	-13084	0	1601	80.70	2.04	594	0.10	0.0	3	1534	69	3.48	67	3.38	0.10	0.2
40.00	7	1610	81.15	2.03	-13150	11	1612	81.25	2.03	550	-0.10	-0.0	5	1539	71	3.58	73	3.68	-0.10	-0.2
40.50	11	1621	81.70	2.02	-13217	6	1618	81.55	2.01	522	0.15	0.1	15	1554	67	3.38	64	3.23	0.15	0.3
41.00	5	1626	81.96	2.00	-13297	23	1641	82.71	2.02	500	-0.76	-0.3	8	1562	64	3.23	79	3.98	-0.76	-1.3
41.50	9	1635	82.41	1.99	-13390	0	1641	82.71	1.99	500	-0.30	-0.1	6	1568	67	3.38	73	3.68	-0.30	-0.5
42.00	3	1638	82.56	1.97	-13471	0	1641	82.71	1.97	500	-0.15	-0.1	3	1571	67	3.38	70	3.53	-0.15	-0.3
42.50	5	1643	82.81	1.95	-13544	0	1641	82.71	1.95	500	0.10	0.0	4	1575	68	3.43	66	3.33	0.10	0.2
43.00	5	1648	83.06	1.93	-13617	7	1648	83.06	1.93	480	0.00	0.0	8	1583	65	3.28	65	3.28	0.00	0.0
43.50	9	1657	83.52	1.92	-13693	4	1652	83.27	1.91	460	0.25	0.1	7	1590	67	3.38	62	3.13	0.25	0.4
44.00	9	1666	83.97	1.91	-13786	9	1661	83.72	1.90	450	0.25	0.1	11	1601	65	3.28	60	3.02	0.25	0.4
44.50	9	1675	84.43	1.90	-13873	7	1668	84.07	1.89	420	0.35	0.1	9	1610	65	3.28	58	2.92	0.35	0.6
45.00	7	1682	84.78	1.88	-13926	23	1691	85.23	1.89	400	-0.45	-0.2	18	1628	54	2.72	63	3.18	-0.45	-0.8
45.50	5	1687	85.03	1.87	-13982	0	1691	85.23	1.87	400	-0.20	-0.1	5	1633	54	2.72	58	2.92	-0.20	-0.4
46.00	5	1692	85.28	1.85	-14056	0	1691	85.23	1.85	400	0.05	0.0	5	1638	54	2.72	53	2.67	0.05	0.1
46.50	10	1702	85.79	1.84	-14143	0	1691	85.23	1.83	400	0.55	0.2	6	1644	58	2.92	47	2.37	0.55	1.1
47.00	3	1705	85.94	1.83	-14224	1	1692	85.28	1.81	376	0.66	0.2	2	1646	59	2.97	46	2.32	0.66	1.3
47.50	2	1707	86.04	1.81	-14294	7	1699	85.64	1.80	360	0.40	0.1	5	1651	56	2.82	48	2.42	0.40	0.8
48.00	7	1714	86.39	1.80	-14358	0	1699	85.64	1.78	350	0.76	0.3	3	1654	60	3.02	45	2.27	0.76	1.5
48.50	6	1720	86.69	1.79	-14417	5	1704	85.89	1.77	326	0.81	0.3	5	1659	61	3.07	45	2.27	0.81	1.6
49.00	13	1733	87.35	1.78	-14496	5	1709	86.14	1.76	320	1.21	0.4	13	1672	61	3.07	37	1.86	1.21	2.4
49.50	5	1738	87.60	1.77	-14563	14	1723	86.84	1.75	300	0.76	0.3	9	1681	57	2.87	42	2.12	0.76	1.5
50.00	1	1739	87.65	1.75	-14643	0	1723	86.84	1.74	300	0.81	0.3	1	1682	57	2.87	41	2.07	0.81	1.6

* See LEGEND, Section C.3.

TABLE C- 2*(cont.)

(TSC)

% Xing	PF	CON 1	CON 2	CON 3	CON 4	% Xing	PF	CON 1	CON 2	CON 3	CON 4
0.50	9.68	3.97	1.83	0.99	0.65	25.50	2.65	3.41	1.94	0.83	0.77
1.00	7.86	3.73	1.71	0.96	0.66	26.00	2.62	3.36	1.94	0.83	0.77
1.50	6.52	3.39	1.55	0.91	0.64	26.50	2.58	3.32	1.94	0.82	0.77
2.00	5.90	3.25	1.51	0.90	0.64	27.00	2.55	3.29	1.95	0.82	0.77
2.50	5.71	3.30	1.55	0.91	0.65	27.50	2.53	3.28	1.96	0.82	0.76
3.00	5.93	3.62	1.69	0.95	0.69	28.00	2.50	3.28	1.97	0.81	0.77
3.50	5.67	3.60	1.69	0.95	0.70	28.50	2.48	3.29	1.98	0.81	0.77
4.00	5.48	3.61	1.70	0.95	0.71	29.00	2.45	3.25	1.98	0.81	0.76
4.50	5.39	3.69	1.74	0.96	0.72	29.50	2.43	3.27	1.99	0.80	0.77
5.00	5.21	3.68	1.74	0.95	0.73	30.00	2.41	3.26	2.00	0.80	0.77
5.50	5.05	3.67	1.74	0.95	0.73	30.50	2.40	3.36	2.02	0.81	0.77
6.00	4.92	3.68	1.75	0.95	0.73	31.00	2.38	3.31	2.03	0.80	0.77
6.50	4.83	3.72	1.77	0.95	0.74	31.50	2.35	3.28	2.03	0.79	0.77
7.00	4.67	3.67	1.76	0.95	0.74	32.00	2.34	3.33	2.05	0.80	0.77
7.50	4.66	3.79	1.80	0.96	0.75	32.50	2.32	3.32	2.06	0.79	0.77
8.00	4.56	3.80	1.81	0.95	0.76	33.00	2.29	3.28	2.07	0.79	0.77
8.50	4.44	3.76	1.80	0.95	0.76	33.50	2.27	3.27	2.07	0.78	0.77
9.00	4.34	3.76	1.80	0.95	0.76	34.00	2.26	3.31	2.09	0.78	0.77
9.50	4.23	3.73	1.80	0.94	0.76	34.50	2.23	3.28	2.10	0.78	0.77
10.00	4.10	3.64	1.78	0.93	0.75	35.00	2.21	3.27	2.11	0.78	0.77
10.50	4.00	3.60	1.77	0.92	0.75	35.50	2.20	3.30	2.12	0.77	0.77
11.00	3.90	3.56	1.77	0.92	0.75	36.00	2.19	3.35	2.14	0.77	0.77
11.50	3.83	3.54	1.77	0.91	0.75	36.50	2.17	3.32	2.15	0.77	0.77
12.00	3.75	3.51	1.77	0.91	0.75	37.00	2.14	3.25	2.15	0.76	0.76
12.50	3.67	3.48	1.77	0.90	0.75	37.50	2.12	3.20	2.16	0.76	0.76
13.00	3.61	3.47	1.77	0.90	0.75	38.00	2.10	3.20	2.17	0.76	0.76
13.50	3.56	3.47	1.78	0.90	0.75	38.50	2.08	3.15	2.18	0.75	0.76
14.00	3.50	3.46	1.78	0.89	0.76	39.00	2.06	3.14	2.19	0.75	0.76
14.50	3.46	3.48	1.79	0.89	0.76	39.50	2.05	3.12	2.20	0.74	0.76
15.00	3.42	3.49	1.80	0.89	0.76	40.00	2.03	3.10	2.21	0.74	0.76
15.50	3.38	3.50	1.81	0.89	0.76	40.50	2.02	3.14	2.23	0.74	0.76
16.00	3.33	3.49	1.82	0.89	0.76	41.00	2.00	3.10	2.24	0.73	0.75
16.50	3.27	3.46	1.82	0.88	0.76	41.50	1.99	3.12	2.26	0.73	0.76
17.00	3.23	3.48	1.83	0.88	0.76	42.00	1.97	3.06	2.27	0.73	0.75
17.50	3.19	3.46	1.83	0.88	0.76	42.50	1.95	3.03	2.28	0.72	0.75
18.00	3.14	3.45	1.83	0.87	0.76	43.00	1.93	2.99	2.29	0.72	0.75
18.50	3.12	3.50	1.85	0.88	0.77	43.50	1.92	3.01	2.31	0.71	0.75
19.00	3.06	3.42	1.84	0.87	0.76	44.00	1.91	3.04	2.32	0.71	0.75
19.50	3.04	3.48	1.86	0.87	0.77	44.50	1.90	3.06	2.34	0.71	0.75
20.00	3.01	3.51	1.87	0.87	0.77	45.00	1.88	3.06	2.36	0.71	0.75
20.50	2.97	3.49	1.88	0.87	0.77	45.50	1.87	3.04	2.37	0.70	0.75
21.00	2.93	3.47	1.88	0.86	0.77	46.00	1.85	3.01	2.39	0.70	0.75
21.50	2.89	3.43	1.88	0.86	0.77	46.50	1.84	3.06	2.41	0.70	0.75
22.00	2.84	3.37	1.88	0.85	0.77	47.00	1.83	3.01	2.42	0.69	0.75
22.50	2.82	3.40	1.89	0.85	0.77	47.50	1.81	2.94	2.43	0.69	0.74
23.00	2.79	3.39	1.90	0.85	0.77	48.00	1.80	2.95	2.45	0.69	0.74
23.50	2.77	3.43	1.91	0.85	0.77	48.50	1.79	2.94	2.47	0.68	0.74
24.00	2.72	3.36	1.91	0.84	0.77	49.00	1.78	3.05	2.50	0.68	0.74
24.50	2.70	3.38	1.92	0.84	0.77	49.50	1.77	3.03	2.52	0.68	0.74
25.00	2.68	3.43	1.94	0.84	0.77	50.00	1.75	2.95	2.53	0.67	0.74

* See Subsection 4.1.2 for discussion of CON 1 - CON 4.

TABLE C-2* (cont.)

(NH)

% Xing	PP	CON 1	CON 2	CON 3	CON 4	% Xing	PP	CON 1	CON 2	CON 3	CON 4
0.50	8.37	3.55	1.58	0.92	0.61	25.50	2.56	3.02	1.87	0.80	0.76
1.00	6.60	3.29	1.48	0.89	0.61	26.00	2.54	3.03	1.89	0.80	0.75
1.50	6.35	3.30	1.51	0.90	0.63	26.50	2.50	2.98	1.89	0.80	0.74
2.00	6.17	3.40	1.58	0.92	0.65	27.00	2.48	2.95	1.89	0.79	0.74
2.50	6.07	3.53	1.65	0.94	0.68	27.50	2.45	2.91	1.89	0.79	0.74
3.00	5.73	3.48	1.63	0.93	0.68	28.00	2.46	3.05	1.93	0.80	0.75
3.50	5.40	3.39	1.61	0.92	0.68	28.50	2.41	2.95	1.92	0.79	0.74
4.00	5.24	3.41	1.63	0.92	0.69	29.00	2.39	2.96	1.93	0.78	0.74
4.50	5.16	3.49	1.67	0.93	0.70	29.50	2.37	2.97	1.95	0.78	0.74
5.00	4.98	3.46	1.66	0.93	0.71	30.00	2.35	2.96	1.96	0.78	0.74
5.50	4.81	3.43	1.66	0.92	0.71	30.50	2.38	3.19	2.00	0.79	0.76
6.00	4.76	3.51	1.69	0.93	0.72	31.00	2.34	3.09	2.00	0.78	0.75
6.50	4.58	3.44	1.68	0.92	0.72	31.50	2.30	2.99	1.99	0.78	0.75
7.00	4.43	3.38	1.67	0.91	0.71	32.00	2.29	3.07	2.01	0.78	0.75
7.50	4.29	3.32	1.66	0.90	0.71	32.50	2.29	3.15	2.04	0.78	0.76
8.00	4.19	3.31	1.66	0.90	0.72	33.00	2.26	3.06	2.03	0.77	0.75
8.50	4.08	3.27	1.65	0.90	0.71	33.50	2.24	3.07	2.05	0.77	0.75
9.00	3.98	3.23	1.65	0.89	0.71	34.00	2.25	3.25	2.08	0.78	0.76
9.50	3.90	3.23	1.66	0.89	0.72	34.50	2.21	3.15	2.06	0.77	0.76
10.00	3.83	3.22	1.66	0.88	0.72	35.00	2.19	3.08	2.08	0.76	0.75
10.50	3.79	3.26	1.68	0.89	0.7[illegible]	35.50	2.17	3.07	2.09	0.76	0.75
11.00	3.74	3.28	1.70	0.89	0.73	36.00	2.16	3.15	2.12	0.76	0.76
11.50	3.68	3.27	1.70	0.89	0.73	36.50	2.14	3.13	2.13	0.76	0.76
12.00	3.65	3.33	1.72	0.89	0.74	37.00	2.12	3.08	2.13	0.75	0.76
12.50	3.59	3.32	1.73	0.89	0.74	37.50	2.10	3.06	2.14	0.75	0.75
13.00	3.59	3.43	1.76	0.90	0.75	38.00	2.12	3.40	2.19	0.77	0.77
13.50	3.51	3.37	1.75	0.89	0.75	38.50	2.10	3.29	2.20	0.76	0.77
14.00	3.45	3.34	1.75	0.88	0.75	39.00	2.07	3.19	2.20	0.75	0.76
14.50	3.35	3.24	1.74	0.87	0.74	39.50	2.04	3.09	2.20	0.74	0.76
15.00	3.32	3.27	1.75	0.87	0.74	40.00	2.03	3.13	2.22	0.74	0.76
15.50	3.26	3.23	1.75	0.87	0.74	40.50	2.01	3.10	2.23	0.74	0.76
16.00	3.26	3.32	1.78	0.87	0.75	41.00	2.02	3.30	2.26	0.74	0.76
16.50	3.16	3.19	1.75	0.86	0.74	41.50	1.99	3.20	2.27	0.74	0.76
17.00	3.13	3.19	1.76	0.86	0.74	42.00	1.97	3.10	2.27	0.73	0.75
17.50	3.10	3.21	1.78	0.86	0.75	42.50	1.95	3.00	2.27	0.72	0.75
18.00	3.05	3.19	1.78	0.85	0.74	43.00	1.93	2.99	2.29	0.72	0.75
18.50	3.03	3.24	1.80	0.85	0.75	43.50	1.91	2.95	2.30	0.71	0.75
19.00	2.95	3.11	1.78	0.84	0.74	44.00	1.90	2.97	2.32	0.71	0.75
19.50	2.92	3.11	1.79	0.84	0.74	44.50	1.89	2.97	2.33	0.71	0.75
20.00	2.88	3.08	1.79	0.83	0.74	45.00	1.89	3.19	2.37	0.71	0.76
20.50	2.92	3.30	1.84	0.85	0.76	45.50	1.87	3.09	2.38	0.71	0.75
21.00	2.85	3.18	1.83	0.84	0.75	46.00	1.85	3.00	2.39	0.70	0.75
21.50	2.78	3.06	1.81	0.83	0.74	46.50	1.83	2.90	2.39	0.69	0.74
22.00	2.74	3.01	1.81	0.82	0.74	47.00	1.81	2.83	2.40	0.69	0.74
22.50	2.73	3.06	1.83	0.82	0.74	47.50	1.80	2.83	2.42	0.68	0.74
23.00	2.69	3.03	1.83	0.82	0.74	48.00	1.78	2.74	2.43	0.68	0.73
23.50	2.66	3.03	1.84	0.81	0.74	48.50	1.77	2.72	2.45	0.67	0.73
24.00	2.65	3.06	1.85	0.81	0.75	49.00	1.76	2.70	2.46	0.67	0.73
24.50	2.61	3.03	1.86	0.81	0.74	49.50	1.75	2.80	2.49	0.67	0.73
25.00	2.61	3.12	1.88	0.82	0.75	50.00	1.74	2.71	2.51	0.66	0.73

* See Subsection 4.1.2 for discussion of CON 1 - CON 4.

TABLE C-3. TSC (VOLUME ONLY) VERSUS NEW HAMPSHIRE FLASHING LIGHTS

FPF01 DAT

% Xing	TSC MODEL INC ACC	TSC MODEL CUM #ACC	TSC MODEL % ACC	TSC MODEL POWER FACTR	TSC MODEL HAZARD INDEX*	NEW HAMPSHIRE CT INC ACC	NEW HAMPSHIRE CT CUM #ACC	NEW HAMPSHIRE CT % ACC	NEW HAMPSHIRE CT POWER FACTR	NEW HAMPSHIRE CT HAZARD INDEX	WITH MATCH %DIFF	WITH MATCH TVAL	INC MTCH	CUM MTCH	TSC LESS MATCH #ACC	TSC LESS MATCH % ACC	NH LESS MATCH #ACC	NH LESS MATCH % ACC	LESS MATCH %DIFF	LESS MATCH TVAL
0.50	56	56	4.23	8.46	-2310	55	55	4.15	8.31	487800	0.08	0.1	55	55	1	0.08	0	0.00	0.08	1.0
1.00	40	96	7.25	7.25	-3472	34	89	6.72	6.72	337790	0.53	0.5	34	89	7	0.53	0	0.00	0.53	2.6
1.50	19	115	8.69	5.79	-4051	26	115	8.69	5.79	268380	0.00	0.0	22	111	4	0.30	4	0.30	0.00	0.0
2.00	27	142	10.73	5.36	-4521	29	144	10.88	5.44	234000	-0.15	-0.1	27	138	4	0.30	6	0.45	-0.15	-0.6
2.50	24	166	12.54	5.02	-4847	25	169	12.76	5.11	210000	-0.23	-0.2	26	164	2	0.15	5	0.38	-0.23	-1.1
3.00	27	193	14.58	4.86	-5218	29	198	14.95	4.98	183820	-0.38	-0.3	27	191	2	0.15	7	0.53	-0.38	-1.7
3.50	20	213	16.09	4.60	-5469	19	217	16.39	4.68	169400	-0.30	-0.2	20	211	2	0.15	6	0.45	-0.30	-1.4
4.00	17	230	17.37	4.34	-5780	14	231	17.45	4.36	153088	-0.08	-0.0	15	226	4	0.30	5	0.38	-0.08	-0.3
4.50	17	247	18.66	4.15	-6075	19	250	18.88	4.20	139000	-0.23	-0.1	19	245	2	0.15	5	0.38	-0.23	-1.1
5.00	19	266	20.09	4.02	-6273	23	273	20.62	4.12	128000	-0.53	-0.3	18	263	3	0.23	10	0.76	-0.53	-1.9
5.50	22	288	21.75	3.95	-6468	23	296	22.36	4.06	120800	-0.60	-0.3	20	283	5	0.38	13	0.98	-0.60	-1.9
6.00	28	316	23.87	3.98	-6633	26	322	24.32	4.05	112720	-0.45	-0.2	23	306	10	0.76	16	1.21	-0.45	-1.2
6.50	21	337	25.45	3.92	-6832	18	340	25.68	3.95	105981	-0.23	-0.1	24	330	7	0.53	10	0.76	-0.23	-0.7
7.00	19	356	26.89	3.84	-7003	24	364	27.49	3.93	100000	-0.60	-0.3	21	351	5	0.38	13	0.98	-0.60	-1.9
7.50	20	376	28.40	3.79	-7160	15	379	28.63	3.82	94560	-0.23	-0.1	20	371	5	0.38	8	0.60	-0.23	-0.8
8.00	15	391	29.53	3.69	-7309	18	397	29.98	3.75	90000	-0.45	-0.2	14	385	6	0.45	12	0.91	-0.45	-1.4
8.50	8	399	30.14	3.55	-7423	10	407	30.74	3.62	85400	-0.60	-0.3	9	394	5	0.38	13	0.98	-0.60	-1.9
9.00	16	415	31.34	3.48	-7535	15	422	31.87	3.54	81700	-0.53	-0.2	13	407	8	0.60	15	1.13	-0.53	-1.5
9.50	12	427	32.25	3.39	-7689	6	428	32.33	3.40	78880	-0.08	-0.0	11	418	9	0.68	10	0.76	-0.08	-0.2
10.00	10	437	33.01	3.30	-7788	12	440	33.23	3.32	75600	-0.23	-0.1	10	428	9	0.68	12	0.91	-0.23	-0.7
10.50	10	447	33.76	3.22	-7900	14	454	34.29	3.27	72000	-0.53	-0.2	10	438	9	0.68	16	1.21	-0.53	-1.4
11.00	21	468	35.35	3.21	-8027	18	472	35.65	3.24	69225	-0.30	-0.1	14	452	16	1.21	20	1.51	-0.30	-0.7
11.50	19	487	36.78	3.20	-8140	20	492	37.16	3.23	66000	-0.38	-0.2	20	472	15	1.13	20	1.51	-0.38	-0.8
12.00	18	505	38.14	3.18	-8257	12	504	38.07	3.17	64000	0.08	0.0	18	490	15	1.13	14	1.06	0.08	0.2
12.50	12	517	39.05	3.12	-8366	11	515	38.90	3.11	61088	0.15	0.1	12	502	15	1.13	13	0.98	0.15	0.4
13.00	11	528	39.88	3.07	-8473	8	523	39.50	3.04	59800	0.38	0.2	11	513	15	1.13	10	0.76	0.38	1.0
13.50	9	537	40.56	3.00	-8573	8	531	40.11	2.97	56480	0.45	0.2	10	523	14	1.06	8	0.60	0.45	1.3
14.00	10	547	41.31	2.95	-8670	16	547	41.31	2.95	54000	0.00	0.0	10	533	14	1.06	14	1.06	0.00	0.0
14.50	11	558	42.15	2.91	-8766	15	562	42.45	2.93	51500	-0.30	-0.1	8	541	17	1.28	21	1.59	-0.30	-0.6
15.00	6	564	42.60	2.84	-8878	9	571	43.13	2.88	49940	-0.53	-0.2	5	546	18	1.36	25	1.89	-0.53	-1.1
15.50	14	578	43.66	2.82	-9015	12	583	44.03	2.84	48000	-0.38	-0.1	13	559	19	1.44	24	1.81	-0.38	-0.8
16.00	14	592	44.71	2.79	-9091	5	588	44.41	2.78	46554	0.30	0.1	11	570	22	1.66	18	1.36	0.30	0.6
16.50	14	606	45.77	2.77	-9192	22	610	46.07	2.79	45000	-0.30	-0.1	12	582	24	1.81	28	2.11	-0.30	-0.6
17.00	11	617	46.60	2.74	-9262	6	616	46.53	2.74	43260	0.08	0.0	11	593	24	1.81	23	1.74	0.08	0.1
17.50	16	633	47.81	2.73	-9361	7	623	47.05	2.69	41990	0.76	0.3	13	606	27	2.04	17	1.28	0.76	1.5
18.00	14	647	48.87	2.71	-9450	17	640	48.34	2.69	40390	0.53	0.2	15	621	26	1.96	19	1.44	0.53	1.0
18.50	10	657	49.62	2.68	-9524	8	648	48.94	2.65	40000	0.68	0.2	10	631	26	1.96	17	1.28	0.68	1.4
19.00	4	661	49.92	2.63	-9613	8	656	49.55	2.61	38800	0.38	0.1	8	639	22	1.66	17	1.28	0.38	0.8
19.50	7	668	50.45	2.59	-9714	13	669	50.53	2.59	37500	-0.08	-0.0	10	649	19	1.44	20	1.51	-0.08	-0.2
20.00	16	684	51.66	2.58	-9781	17	686	51.81	2.59	36000	-0.15	-0.1	17	666	18	1.36	20	1.51	-0.15	-0.3
20.50	7	691	52.19	2.55	-9845	6	692	52.27	2.55	35000	-0.08	-0.0	6	672	19	1.44	20	1.51	-0.08	-0.2
21.00	5	696	52.57	2.50	-9914	8	700	52.87	2.52	34000	-0.30	-0.1	8	680	16	1.21	20	1.51	-0.30	-0.7
21.50	10	706	53.32	2.48	-10007	9	709	53.55	2.49	33000	-0.23	-0.1	8	688	18	1.36	21	1.59	-0.23	-0.5
22.00	14	720	54.38	2.47	-10089	6	715	54.00	2.45	32000	0.38	0.1	9	697	23	1.74	18	1.36	0.38	0.8
22.50	7	727	54.91	2.44	-10157	7	722	54.53	2.42	30940	0.38	0.1	8	705	22	1.66	17	1.28	0.38	0.8
23.00	6	733	55.36	2.41	-10229	9	731	55.21	2.40	30000	0.15	0.1	6	711	22	1.66	20	1.51	0.15	0.3
23.50	6	739	55.82	2.38	-10305	4	735	55.51	2.36	29700	0.30	0.1	6	717	22	1.66	18	1.36	0.30	0.6
24.00	10	749	56.57	2.36	-10369	9	744	56.19	2.34	28800	0.38	0.1	11	728	21	1.59	16	1.21	0.38	0.8
24.50	4	753	56.87	2.32	-10443	9	753	56.87	2.32	28000	0.00	0.0	5	733	20	1.51	20	1.51	0.00	0.0
25.00	9	762	57.55	2.30	-10519	9	762	57.55	2.30	27000	0.00	0.0	9	742	20	1.51	20	1.51	0.00	0.0

* See LEGEND, Section C.3.

TABLE C-3. (cont.)

FPF01 DAT

% Xing	TSC MODEL INC ACC	TSC MODEL CUM #ACC	TSC MODEL % ACC	TSC MODEL POWER FACTR	TSC MODEL HAZARD* INDEX	NEW HAMPSHIRE CT INC ACC	NEW HAMPSHIRE CT CUM #ACC	NEW HAMPSHIRE CT % ACC	NEW HAMPSHIRE CT POWER FACTR	NEW HAMPSHIRE CT HAZARD INDEX	WITH MATCH %DIFF	WITH MATCH TVAL	INC MTCH	CUM MTCH	TSC LESS #ACC	TSC MATCH % ACC	NH LESS #ACC	NH MATCH % ACC	LESS MATCH %DIFF	LESS MATCH TVAL
25.50	5	767	57.93	2.27	-10608	7	769	58.08	2.28	26270	-0.15	-0.1	7	749	18	1.36	20	1.51	-0.15	-0.3
26.00	9	776	58.61	2.25	-10657	13	782	59.06	2.27	25600	-0.45	-0.2	12	761	15	1.13	21	1.59	-0.45	-1.0
26.50	9	785	59.29	2.24	-10714	7	789	59.59	2.25	25000	-0.30	-0.1	5	766	19	1.44	23	1.74	-0.30	-0.6
27.00	11	796	60.12	2.23	-10789	6	795	60.05	2.22	24290	0.08	0.0	9	775	21	1.59	20	1.51	0.08	0.2
27.50	6	802	60.57	2.20	-10861	5	800	60.42	2.20	24000	0.15	0.0	6	781	21	1.59	19	1.44	0.15	0.3
28.00	8	810	61.18	2.18	-10917	5	805	60.80	2.17	23200	0.38	0.1	6	787	23	1.74	18	1.36	0.38	0.8
28.50	10	820	61.93	2.17	-10988	13	818	61.78	2.17	22500	0.15	0.0	12	799	21	1.59	19	1.44	0.15	0.3
29.00	3	823	62.16	2.14	-11060	7	825	62.31	2.15	22000	-0.15	-0.0	4	803	20	1.51	22	1.66	-0.15	-0.3
29.50	10	833	62.92	2.13	-11121	8	833	62.92	2.13	21440	0.00	0.0	7	810	23	1.74	23	1.74	0.00	0.0
30.00	8	841	63.52	2.12	-11184	4	837	63.22	2.11	20900	0.30	0.1	9	819	22	1.66	18	1.36	0.30	0.6
30.50	5	846	63.90	2.09	-11234	4	841	63.52	2.08	20400	0.38	0.1	4	823	23	1.74	18	1.36	0.38	0.8
31.00	10	856	64.65	2.09	-11325	5	846	63.90	2.06	20000	0.76	0.2	8	831	25	1.89	15	1.13	0.76	1.6
31.50	10	866	65.41	2.08	-11387	1	847	63.97	2.03	19680	1.44	0.5	5	836	30	2.27	11	0.83	1.44	3.0
32.00	6	872	65.86	2.06	-11438	8	855	64.58	2.02	19200	1.28	0.4	7	843	29	2.19	12	0.91	1.28	2.7
32.50	4	876	66.16	2.04	-11487	5	860	64.95	2.00	18792	1.21	0.4	5	848	28	2.11	12	0.91	1.21	2.5
33.00	7	883	66.69	2.02	-11545	12	872	65.86	2.00	18040	0.83	0.3	7	855	28	2.11	17	1.28	0.83	1.6
33.50	2	885	66.84	2.00	-11589	6	878	66.31	1.98	18000	0.53	0.2	2	857	28	2.11	21	1.59	0.53	1.0
34.00	4	889	67.15	1.97	-11645	8	886	66.92	1.97	17325	0.23	0.1	6	863	26	1.96	23	1.74	0.23	0.4
34.50	4	893	67.45	1.95	-11704	6	892	67.37	1.95	16848	0.08	0.0	5	868	25	1.89	24	1.81	0.08	0.1
35.00	8	901	68.05	1.94	-11762	11	903	68.20	1.95	16380	-0.15	-0.0	8	876	25	1.89	27	2.04	-0.15	-0.3
35.50	9	910	68.73	1.94	-11823	4	907	68.50	1.93	16000	0.23	0.1	9	885	25	1.89	22	1.66	0.23	0.4
36.00	8	918	69.34	1.93	-11897	4	911	68.81	1.91	15600	0.53	0.2	5	890	28	2.11	21	1.59	0.53	1.0
36.50	6	924	69.79	1.91	-11945	0	911	68.81	1.89	15230	0.98	0.3	5	895	29	2.19	16	1.21	0.98	1.9
37.00	8	932	70.39	1.90	-12003	8	919	69.41	1.88	15000	0.98	0.3	9	904	28	2.11	15	1.13	0.98	2.0
37.50	9	941	71.07	1.90	-12073	3	922	69.64	1.86	14560	1.44	0.4	7	911	30	2.27	11	0.83	1.44	3.0
38.00	4	945	71.37	1.88	-42140	5	927	70.02	1.84	14220	1.36	0.4	6	917	28	2.11	10	0.76	1.36	2.9
38.50	4	949	71.68	1.86	-12220	8	935	70.62	1.83	14000	1.06	0.3	3	920	29	2.19	15	1.13	1.06	2.1
39.00	8	957	72.28	1.85	-12284	11	946	71.45	1.83	13600	0.83	0.3	8	928	29	2.19	18	1.36	0.83	1.6
39.50	0	957	72.28	1.83	-12323	7	953	71.98	1.82	13200	0.30	0.1	3	931	26	1.96	22	1.66	0.30	0.6
40.00	3	960	72.51	1.81	-12380	5	958	72.36	1.81	12800	0.15	0.0	2	933	27	2.04	25	1.89	0.15	0.3
40.50	4	964	72.81	1.80	-12445	6	964	72.81	1.80	12500	0.00	0.0	6	939	25	1.89	25	1.89	0.00	0.0
41.00	6	970	73.26	1.79	-12495	19	983	74.24	1.81	12000	-0.98	-0.3	8	947	23	1.74	36	2.72	-0.98	-1.7
41.50	5	975	73.64	1.77	-12576	0	983	74.24	1.79	12000	-0.60	-0.2	3	950	25	1.89	33	2.49	-0.60	-1.1
42.00	3	978	73.87	1.76	-12630	1	984	74.32	1.77	11792	-0.45	-0.1	3	953	25	1.89	31	2.34	-0.45	-0.8
42.50	8	986	74.47	1.75	-12683	4	988	74.62	1.76	11388	-0.15	-0.0	5	958	28	2.11	30	2.27	-0.15	-0.3
43.00	10	996	75.23	1.75	-12750	1	989	74.70	1.74	11025	0.53	0.2	6	964	32	2.42	25	1.89	0.53	0.9
43.50	9	1005	75.91	1.74	-12814	4	993	75.00	1.72	10800	0.91	0.3	11	975	30	2.27	18	1.36	0.91	1.7
44.00	8	1013	76.51	1.74	-12885	8	1001	75.60	1.72	10500	0.91	0.3	6	981	32	2.42	20	1.51	0.91	1.7
44.50	8	1021	77.11	1.73	-12939	8	1009	76.21	1.71	10200	0.91	0.3	11	992	29	2.19	17	1.28	0.91	1.8
45.00	4	1025	77.42	1.72	-12996	10	1019	76.96	1.71	10000	0.45	0.1	4	996	29	2.19	23	1.74	0.45	0.8
45.50	4	1029	77.72	1.71	-13047	1	1020	77.04	1.69	9840	0.68	0.2	2	998	31	2.34	22	1.66	0.68	1.2
46.00	5	1034	78.10	1.70	-13087	3	1023	77.27	1.68	9600	0.83	0.2	5	1003	31	2.34	20	1.51	0.83	1.5
46.50	3	1037	78.32	1.68	-13140	2	1025	77.42	1.66	9324	0.91	0.3	3	1006	31	2.34	19	1.44	0.91	1.7
47.00	6	1043	78.78	1.68	-13198	6	1031	77.87	1.66	9180	0.91	0.3	5	1011	32	2.42	20	1.51	0.91	1.7
47.50	4	1047	79.08	1.66	-13269	13	1044	78.85	1.66	9000	0.23	0.1	11	1022	25	1.89	22	1.66	0.23	0.4
48.00	6	1053	79.53	1.66	-13322	4	1048	79.15	1.65	8800	0.38	0.1	4	1026	27	2.04	22	1.66	0.38	0.7
48.50	5	1058	79.91	1.65	-13378	6	1054	79.61	1.64	8500	0.30	0.1	9	1035	23	1.74	19	1.44	0.30	0.6
49.00	4	1062	80.21	1.64	-13404	8	1062	80.21	1.64	8250	0.00	0.0	7	1042	20	1.51	20	1.51	0.00	0.0
49.50	5	1067	80.59	1.63	-13472	9	1071	80.89	1.63	8000	-0.30	-0.1	3	1045	22	1.66	26	1.96	-0.30	-0.6
50.00	6	1073	81.04	1.62	-13535	0	1071	80.89	1.62	8000	0.15	0.0	2	1047	26	1.96	24	1.81	0.15	0.3

* See LEGEND, Section C.3.

TABLE C-4. TSC (COMPREHENSIVE) VERSUS NEW HAMPSHIRE FLASHING LIGHTS

FLCN1 DAT

CT

% Xing	TSC MODEL INC ACC	TSC MODEL CUM #ACC	TSC MODEL % ACC	TSC MODEL POWER FACTR	TSC MODEL HAZARD* INDEX	NEW HAMPSHIRE INC ACC	NEW HAMPSHIRE CUM #ACC	NEW HAMPSHIRE % ACC	NEW HAMPSHIRE POWER FACTR	NEW HAMPSHIRE HAZARD INDEX	WITH MATCH %DIFF	WITH MATCH TVAL	INC MTCH	CUM MTCH	TSC LESS MATCH #ACC	TSC LESS MATCH % ACC	NH LESS MATCH #ACC	NH LESS MATCH % ACC	LESS MATCH %DIFF	LESS MATCH TVAL
0.50	63	63	4.76	9.52	-1801	55	55	4.15	8.31	487800	0.60	0.7	43	43	20	1.51	12	0.91	0.60	1.4
1.00	37	100	7.55	7.55	-2932	34	89	6.72	6.72	337790	0.83	0.8	27	70	30	2.27	19	1.44	0.83	1.6
1.50	27	127	9.59	6.39	-3649	26	115	8.69	5.79	268380	0.91	0.8	22	92	35	2.64	23	1.74	0.91	1.6
2.00	25	152	11.48	5.74	-4050	29	144	10.88	5.44	234000	0.60	0.5	32	124	28	2.11	20	1.51	0.60	1.2
2.50	18	170	12.84	5.14	-4537	25	169	12.76	5.11	210000	0.08	0.1	22	146	24	1.81	23	1.74	0.08	0.1
3.00	22	192	14.50	4.83	-4888	29	198	14.95	4.98	183820	-0.45	-0.3	19	165	27	2.04	33	2.49	-0.45	-0.8
3.50	30	222	16.77	4.79	-5212	19	217	16.39	4.68	169400	0.38	0.2	30	195	27	2.04	22	1.66	0.38	0.7
4.00	19	241	18.20	4.55	-5479	14	231	17.45	4.36	153088	0.76	0.5	11	206	35	2.64	25	1.89	0.76	1.3
4.50	25	266	20.09	4.46	-5751	19	250	18.88	4.20	139000	1.21	0.7	22	228	38	2.87	22	1.66	1.21	2.1
5.00	22	288	21.75	4.35	-5972	23	273	20.62	4.12	128000	1.13	0.6	19	247	41	3.10	26	1.96	1.13	1.8
5.50	18	306	23.11	4.20	-6219	23	296	22.36	4.06	120800	0.76	0.4	18	265	41	3.10	31	2.34	0.76	1.2
6.00	24	330	24.92	4.15	-6392	26	322	24.32	4.05	112720	0.60	0.3	26	291	39	2.95	31	2.34	0.60	1.0
6.50	18	348	26.28	4.04	-6580	18	340	25.68	3.95	106981	0.60	0.3	14	305	43	3.25	35	2.64	0.60	0.9
7.00	19	367	27.72	3.96	-6756	24	364	27.49	3.93	100000	0.23	0.1	22	327	40	3.02	37	2.79	0.23	0.3
7.50	18	385	29.08	3.88	-6915	15	379	28.63	3.82	94560	0.45	0.2	13	340	45	3.40	39	2.95	0.45	0.7
8.00	13	398	30.06	3.76	-7025	18	397	29.98	3.75	90000	0.08	0.0	15	355	43	3.25	42	3.17	0.08	0.1
8.50	12	410	30.97	3.64	-7167	10	407	30.74	3.62	85400	0.23	0.1	13	368	42	3.17	39	2.95	0.23	0.3
9.00	20	430	32.48	3.61	-7312	15	422	31.87	3.54	81700	0.60	0.3	13	381	49	3.70	41	3.10	0.60	0.8
9.50	17	447	33.76	3.55	-7458	6	428	32.33	3.40	78880	1.44	0.6	11	392	55	4.15	36	2.72	1.44	2.0
10.00	14	461	34.82	3.48	-7598	12	440	33.23	3.32	75600	1.59	0.7	17	409	52	3.93	31	2.34	1.59	2.3
10.50	14	475	35.88	3.42	-7775	14	454	34.29	3.27	72000	1.59	0.7	17	426	49	3.70	28	2.11	1.59	2.4
11.00	13	488	36.86	3.35	-7872	18	472	35.65	3.24	69225	1.21	0.5	19	445	43	3.25	27	2.04	1.21	1.9
11.50	11	499	37.69	3.28	-7998	20	492	37.16	3.23	66000	0.53	0.2	12	457	42	3.17	35	2.64	0.53	0.8
12.00	19	518	39.12	3.26	-8116	12	504	38.07	3.17	64000	1.06	0.4	16	473	45	3.40	31	2.34	1.06	1.6
12.50	15	533	40.26	3.22	-8214	11	515	38.90	3.11	61088	1.36	0.6	13	486	47	3.55	29	2.19	1.36	2.1
13.00	12	545	41.16	3.17	-8319	8	523	39.50	3.04	59800	1.66	0.7	7	493	52	3.93	30	2.27	1.66	2.4
13.50	10	555	41.92	3.11	-8447	8	531	40.11	2.97	56480	1.81	0.7	9	502	53	4.00	29	2.19	1.81	2.7
14.00	16	571	43.13	3.08	-8553	16	547	41.31	2.95	54000	1.81	0.7	14	516	55	4.15	31	2.34	1.81	2.6
14.50	8	579	43.73	3.02	-8654	15	562	42.45	2.93	51500	1.28	0.5	16	532	47	3.55	30	2.27	1.28	1.9
15.00	11	590	44.56	2.97	-8746	9	571	43.13	2.88	49940	1.44	0.6	9	541	49	3.70	30	2.27	1.44	2.1
15.50	12	602	45.47	2.93	-8880	12	583	44.03	2.84	48000	1.44	0.6	14	555	47	3.55	28	2.11	1.44	2.2
16.00	13	615	46.45	2.90	-8995	5	588	44.41	2.78	46554	2.04	0.8	7	562	53	4.00	26	1.96	2.04	3.0
16.50	11	626	47.28	2.87	-9095	22	610	46.07	2.79	45000	1.21	0.5	20	582	44	3.32	28	2.11	1.21	1.9
17.00	10	636	48.04	2.83	-9188	6	616	46.53	2.74	43260	1.51	0.6	8	590	46	3.47	26	1.96	1.51	2.4
17.50	14	650	49.09	2.81	-9294	7	623	47.05	2.69	41990	2.04	0.8	13	603	47	3.55	20	1.51	2.04	3.3
18.00	8	658	49.70	2.76	-9387	17	640	48.34	2.69	40390	1.36	0.5	13	616	42	3.17	24	1.81	1.36	2.2
18.50	10	668	50.45	2.73	-9465	8	648	48.94	2.65	40000	1.51	0.6	8	624	44	3.32	24	1.81	1.51	2.4
19.00	10	678	51.21	2.70	-9580	8	656	49.55	2.61	38800	1.66	0.6	10	634	44	3.32	22	1.66	1.66	2.7
19.50	5	683	51.59	2.65	-9656	13	669	50.53	2.59	37500	1.06	0.4	14	648	35	2.64	21	1.59	1.06	1.9
20.00	11	694	52.42	2.62	-9749	17	686	51.81	2.59	36000	0.60	0.2	13	661	33	2.49	25	1.89	0.60	1.1
20.50	5	699	52.79	2.58	-9836	6	692	52.27	2.55	35000	0.53	0.2	7	668	31	2.34	24	1.81	0.53	0.9
21.00	5	704	53.17	2.53	-9938	8	700	52.87	2.52	34000	0.30	0.1	6	674	30	2.27	26	1.96	0.30	0.5
21.50	6	710	53.63	2.49	-10011	9	709	53.55	2.49	33000	0.08	0.0	4	678	32	2.42	31	2.34	0.08	0.1
22.00	13	723	54.61	2.48	-10090	6	715	54.00	2.45	32000	0.60	0.2	10	688	35	2.64	27	2.04	0.60	1.0
22.50	7	730	55.14	2.45	-10166	7	722	54.53	2.42	30940	0.60	0.2	6	694	36	2.72	28	2.11	0.60	1.0
23.00	10	740	55.89	2.43	-10250	9	731	55.21	2.40	30000	0.68	0.2	9	703	37	2.79	28	2.11	0.68	1.1
23.50	7	747	56.42	2.40	-10327	4	735	55.51	2.36	29700	0.91	0.3	6	709	38	2.87	26	1.96	0.91	1.5
24.00	10	757	57.18	2.35	-10418	9	744	56.19	2.34	28800	0.98	0.3	9	718	39	2.95	26	1.96	0.98	1.6
24.50	9	766	57.85	2.36	-10516	9	753	56.87	2.32	28000	0.98	0.3	3	721	45	3.40	32	2.42	0.98	1.5
25.00	3	769	58.08	2.32	-10595	9	762	57.55	2.30	27000	0.53	0.2	8	729	40	3.02	33	2.49	0.53	0.8

* See LEGEND, Section C.3.

TABLE C-4 (cont.)

FLCN1 DAT

% Xing	TSC MODEL INC ACC	CUM #ACC	% ACC	POWER FACTR	HAZARD INDEX*	NEW HAMPSHIRE CT INC ACC	CUM #ACC	% ACC	POWER FACTR	HAZARD INDEX	WITH MATCH %DIFF	TVAL	INC MTCH	CUM MTCH	TSC LESS #ACC	MATCH % ACC	NH LESS #ACC	MATCH % ACC	LESS MATCH %DIFF	TVAL
25.50	3	772	58.31	2.29	-10675	7	769	58.08	2.28	26270	0.23	0.1	6	735	37	2.79	34	2.57	0.23	0.4
26.00	5	777	58.69	2.26	-10759	13	782	59.06	2.27	25600	-0.38	-0.1	10	745	32	2.42	37	2.79	-0.38	-0.6
26.50	9	786	59.37	2.24	-10832	7	789	59.59	2.25	25000	-0.23	-0.1	10	755	31	2.34	34	2.57	-0.23	-0.4
27.00	8	794	59.97	2.22	-10900	6	795	60.05	2.22	24290	-0.08	-0.0	8	763	31	2.34	32	2.42	-0.08	-0.1
27.50	5	799	60.35	2.19	-10971	5	800	60.42	2.20	24000	-0.08	-0.0	6	769	30	2.27	31	2.34	-0.08	-0.1
28.00	3	802	60.57	2.16	-11037	5	805	60.80	2.17	23200	-0.23	-0.1	5	774	28	2.11	31	2.34	-0.23	-0.4
28.50	8	810	61.18	2.15	-11099	13	818	61.78	2.17	22500	-0.60	-0.2	8	782	28	2.11	36	2.72	-0.60	-1.0
29.00	7	817	61.71	2.13	-11162	7	825	62.31	2.15	22000	-0.60	-0.2	8	790	27	2.04	35	2.64	-0.60	-1.0
29.50	6	823	62.16	2.11	-11238	8	833	62.92	2.13	21440	-0.76	-0.2	5	795	28	2.11	38	2.87	-0.76	-1.2
30.00	7	830	62.69	2.09	-11310	4	837	63.22	2.11	20900	-0.53	-0.2	6	801	29	2.19	36	2.72	-0.53	-0.9
30.50	7	837	63.22	2.07	-11379	4	841	63.52	2.08	20400	-0.30	-0.1	4	805	32	2.42	36	2.72	-0.30	-0.5
31.00	13	850	64.20	2.07	-11445	5	846	63.90	2.06	20000	0.30	0.1	9	814	36	2.72	32	2.42	0.30	0.5
31.50	8	858	64.80	2.06	-11518	1	847	63.97	2.03	19680	0.83	0.3	3	817	41	3.10	30	2.27	0.83	1.3
32.00	4	862	65.11	2.03	-11585	8	855	64.58	2.02	19200	0.53	0.2	5	822	40	3.02	33	2.49	0.53	0.8
32.50	8	870	65.71	2.02	-11647	5	860	64.95	2.00	18792	0.76	0.2	7	829	41	3.10	31	2.34	0.76	1.2
33.00	9	879	66.39	2.01	-11720	12	872	65.86	2.00	18040	0.53	0.2	11	840	39	2.95	32	2.42	0.53	0.8
33.50	10	889	67.15	2.00	-11784	6	878	66.31	1.98	18000	0.83	0.3	7	847	42	3.17	31	2.34	0.83	1.3
34.00	5	894	67.52	1.99	-11852	8	886	66.92	1.97	17325	0.60	0.2	7	854	40	3.02	32	2.42	0.60	0.9
34.50	7	901	68.05	1.97	-11915	6	892	67.37	1.95	16848	0.68	0.2	4	858	43	3.25	34	2.57	0.68	1.0
35.00	5	906	68.43	1.96	-11982	11	903	68.20	1.95	16380	0.23	0.1	9	867	39	2.95	36	2.72	0.23	0.3
35.50	6	912	68.88	1.94	-12048	4	907	68.50	1.93	16000	0.38	0.1	7	874	38	2.87	33	2.49	0.38	0.6
36.00	9	921	69.56	1.93	-12114	4	911	68.81	1.91	15600	0.76	0.2	6	880	41	3.10	31	2.34	0.76	1.2
36.50	2	923	69.71	1.91	-12185	0	911	68.81	1.89	15230	0.91	0.3	1	881	42	3.17	30	2.27	0.91	1.4
37.00	6	929	70.17	1.90	-12254	8	919	69.41	1.88	15000	0.76	0.2	6	887	42	3.17	32	2.42	0.76	1.2
37.50	8	937	70.77	1.89	-12335	3	922	69.64	1.86	14560	1.13	0.3	7	894	43	3.25	28	2.11	1.13	1.8
38.00	10	947	71.53	1.88	-12410	5	927	70.02	1.84	14220	1.51	0.5	7	901	46	3.47	26	1.96	1.51	2.4
38.50	7	954	72.05	1.87	-12470	8	935	70.62	1.83	14000	1.44	0.4	6	907	47	3.55	28	2.11	1.44	2.2
39.00	8	962	72.66	1.86	-12537	11	946	71.45	1.83	13600	1.21	0.4	11	918	44	3.32	28	2.11	1.21	1.9
39.50	5	967	73.04	1.85	-12598	7	953	71.98	1.82	13200	1.06	0.3	4	922	45	3.40	31	2.34	1.06	1.6
40.00	4	971	73.34	1.83	-12652	5	958	72.36	1.81	12800	0.98	0.3	6	928	43	3.25	30	2.27	0.98	1.5
40.50	7	978	73.87	1.82	-12711	6	964	72.81	1.80	12500	1.06	0.3	7	935	43	3.25	29	2.19	1.06	1.6
41.00	9	987	74.55	1.82	-12772	19	983	74.24	1.81	12000	0.30	0.1	14	949	38	2.87	34	2.57	0.30	0.5
41.50	3	990	74.77	1.80	-12832	0	983	74.24	1.79	12000	0.53	0.2	1	950	40	3.02	33	2.49	0.53	0.8
42.00	3	993	75.00	1.79	-12896	1	984	74.32	1.77	11792	0.68	0.2	2	952	41	3.10	32	2.42	0.68	1.1
42.50	8	1001	75.60	1.78	-12981	4	988	74.62	1.76	11388	0.98	0.3	4	956	45	3.40	32	2.42	0.98	1.5
43.00	5	1006	75.98	1.77	-13041	1	989	74.70	1.74	11025	1.28	0.4	4	960	46	3.47	29	2.19	1.28	2.0
43.50	4	1010	76.28	1.75	-13085	4	993	75.00	1.72	10800	1.28	0.4	4	964	46	3.47	29	2.19	1.28	2.0
44.00	5	1015	76.66	1.74	-13146	8	1001	75.60	1.72	10500	1.06	0.3	8	972	43	3.25	29	2.19	1.06	1.6
44.50	4	1019	76.96	1.73	-13203	8	1009	76.21	1.71	10200	0.76	0.2	8	980	39	2.95	29	2.19	0.76	1.2
45.00	6	1025	77.42	1.72	-13270	10	1019	76.96	1.71	10000	0.45	0.1	9	989	36	2.72	30	2.27	0.45	0.7
45.50	5	1030	77.79	1.71	-13345	1	1020	77.04	1.69	9840	0.76	0.2	1	990	40	3.02	30	2.27	0.76	1.2
46.00	8	1038	78.40	1.70	-13411	3	1023	77.27	1.68	9600	1.13	0.3	8	998	40	3.02	25	1.89	1.13	1.9
46.50	6	1044	78.85	1.70	-13477	2	1025	77.42	1.66	9324	1.44	0.4	4	1002	42	3.17	23	1.74	1.44	2.4
47.00	5	1049	79.23	1.69	-13520	6	1031	77.87	1.66	9180	1.36	0.4	7	1009	40	3.02	22	1.66	1.36	2.3
47.50	5	1054	79.61	1.68	-13566	13	1044	78.85	1.66	9000	0.76	0.2	11	1020	34	2.57	24	1.81	0.76	1.3
48.00	5	1059	79.98	1.67	-13646	4	1048	79.15	1.65	8800	0.83	0.2	4	1024	35	2.64	24	1.81	0.83	1.4
48.50	5	1064	80.36	1.66	-13704	6	1054	79.61	1.64	8500	0.76	0.2	5	1029	35	2.64	25	1.89	0.76	1.3
49.00	7	1071	80.89	1.65	-13777	8	1062	80.21	1.64	8250	0.68	0.2	11	1040	31	2.34	22	1.66	0.68	1.2
49.50	1	1072	80.97	1.64	-13832	9	1071	80.89	1.63	8003	0.08	0.0	1	1041	31	2.34	30	2.27	0.08	0.1
50.00	7	1079	81.50	1.63	-13899	0	1071	80.89	1.62	8000	0.60	0.2	5	1046	33	2.49	25	1.89	0.60	1.1

* See LEGEND, Section C.3.

TABLE C-5. TSC (VOLUME ONLY) VERSUS NEW HAMPSHIRE AUTOMATIC GATES

GPF01 DAT

CT

% Xing	TSC MODEL INC ACC	TSC MODEL CUM #ACC	TSC MODEL % ACC	TSC MODEL POWER FACTR	TSC MODEL HAZARD INDEX *	NEW HAMPSHIRE INC ACC	NEW HAMPSHIRE CUM #ACC	NEW HAMPSHIRE % ACC	NEW HAMPSHIRE POWER FACTR	NEW HAMPSHIRE HAZARD INDEX	WITH MATCH %DIFF	WITH MATCH TVAL	INC MTCH	CUM MTCH	TSC LESS MATCH #ACC	TSC LESS MATCH % ACC	NH LESS MATCH #ACC	NH LESS MATCH % ACC	LESS MATCH %DIFF	LESS MATCH TVAL
0.50	7	7	1.98	3.95	-4844	7	7	1.98	3.95	1272000	0.00	0.0	4	4	3	0.85	3	0.85	0.00	0.0
1.00	8	15	4.24	4.24	-5477	7	14	3.95	3.95	939420	0.28	0.2	7	11	4	1.13	3	0.85	0.28	0.4
1.50	11	26	7.34	4.90	-5925	5	19	5.37	3.58	819360	1.98	1.0	4	15	11	3.11	4	1.13	1.98	1.8
2.00	7	33	9.32	4.66	-6170	5	24	6.78	3.39	748000	2.54	1.2	4	19	14	3.95	5	1.41	2.54	2.1
2.50	3	36	10.17	4.07	-6418	3	27	7.63	3.05	677660	2.54	1.1	3	22	14	3.95	5	1.41	2.54	2.1
3.00	2	38	10.73	3.58	-6710	8	35	9.89	3.30	593400	0.85	0.4	7	29	9	2.54	6	1.69	0.85	0.8
3.50	10	48	13.56	3.87	-6968	9	44	12.43	3.55	540000	1.13	0.4	10	39	9	2.54	5	1.41	1.13	1.1
4.00	2	50	14.12	3.53	-7208	2	46	12.99	3.25	488400	1.13	0.4	1	40	10	2.82	6	1.69	1.13	1.0
4.50	4	54	15.25	3.39	-7353	3	49	13.84	3.08	458080	1.41	0.5	1	41	13	3.67	8	2.26	1.41	1.1
5.00	6	60	16.95	3.39	-7507	0	49	13.84	2.77	425000	3.11	1.1	0	41	19	5.37	8	2.25	3.11	2.1
5.50	4	64	18.08	3.29	-7719	5	54	15.25	2.77	400320	2.82	0.9	3	44	20	5.65	10	2.82	2.82	1.8
6.00	0	64	18.08	3.01	-7902	11	65	18.36	3.06	373800	-0.28	-0.1	6	50	14	3.95	15	4.24	-0.28	-0.2
6.50	5	69	19.49	3.00	-8036	7	72	20.34	3.13	350000	-0.85	-0.3	7	57	12	3.39	15	4.24	-0.85	-0.6
7.00	4	73	20.62	2.95	-8168	5	77	21.75	3.11	334400	-1.13	-0.3	2	59	14	3.95	18	5.08	-1.13	-0.7
7.50	5	78	22.03	2.94	-8255	2	79	22.32	2.98	321600	-0.28	-0.1	6	65	13	3.67	14	3.95	-0.28	-0.2
8.00	5	83	23.45	2.93	-8370	4	83	23.45	2.93	308100	0.00	0.0	3	68	15	4.24	15	4.24	0.00	0.0
8.50	4	87	24.58	2.89	-8443	6	89	25.14	2.96	297600	-0.56	-0.2	4	72	15	4.24	17	4.80	-0.56	-0.4
9.00	1	88	24.86	2.76	-8532	1	90	25.42	2.82	285200	-0.56	-0.1	1	73	15	4.24	17	4.80	-0.56	-0.4
9.50	4	92	25.99	2.74	-8603	4	94	26.55	2.80	270100	-0.56	-0.1	5	78	14	3.95	16	4.52	-0.56	-0.4
10.00	3	95	26.84	2.68	-8680	2	96	27.12	2.71	261000	-0.28	-0.1	1	79	16	4.52	17	4.80	-0.28	-0.2
10.50	2	97	27.40	2.61	-8781	0	96	27.12	2.58	254400	0.28	0.1	1	80	17	4.80	16	4.52	0.28	0.2
11.00	6	103	29.10	2.65	-8858	0	96	27.12	2.47	246400	1.98	0.5	0	80	23	6.50	16	4.52	1.98	1.1
11.50	1	104	29.38	2.55	-8921	4	100	28.25	2.46	237000	1.13	0.3	3	83	21	5.93	17	4.80	1.13	0.6
12.00	1	105	29.66	2.47	-9005	4	104	29.38	2.45	228600	0.28	0.1	2	85	20	5.65	19	5.37	0.28	0.2
12.50	1	106	29.94	2.40	-9038	7	111	31.36	2.51	220000	-1.41	-0.3	5	90	16	4.52	21	5.93	-1.41	-0.8
13.00	4	110	31.07	2.39	-9098	2	113	31.92	2.46	210000	-0.85	-0.2	2	92	18	5.08	21	5.93	-0.85	-0.5
13.50	4	114	32.20	2.39	-9177	0	113	31.92	2.36	202800	0.28	0.1	1	93	21	5.93	20	5.65	0.28	0.2
14.00	5	119	33.62	2.40	-9234	2	115	32.49	2.32	197145	1.13	0.3	3	96	23	6.50	19	5.37	1.13	0.6
14.50	4	123	34.75	2.40	-9317	2	117	33.05	2.28	190400	1.69	0.4	3	99	24	6.78	18	5.08	1.69	0.9
15.00	3	126	35.59	2.37	-9380	5	122	34.46	2.30	183720	1.13	0.3	2	101	25	7.06	21	5.93	1.13	0.6
15.50	4	130	36.72	2.37	-9414	3	125	35.31	2.28	173600	1.41	0.3	6	107	23	6.50	18	5.08	1.41	0.8
16.00	3	133	37.57	2.35	-9488	2	127	35.88	2.24	170000	1.69	0.4	3	110	23	6.50	17	4.80	1.69	0.9
16.50	10	143	40.40	2.45	-9572	2	129	36.44	2.21	168000	3.95	0.8	4	114	29	8.19	15	4.24	3.95	2.1
17.00	4	147	41.53	2.44	-9642	3	132	37.29	2.19	161500	4.24	0.9	2	116	31	8.76	16	4.52	4.24	2.2
17.50	0	147	41.53	2.37	-9687	4	136	38.42	2.20	155800	3.11	0.7	1	117	30	8.47	19	5.37	3.11	1.6
18.00	4	151	42.66	2.37	-9761	3	139	39.27	2.18	150000	3.39	0.7	2	119	32	9.04	20	5.65	3.39	1.7
18.50	2	153	43.22	2.34	-9804	2	141	39.83	2.15	147400	3.39	0.7	2	121	32	9.04	20	5.65	3.39	1.7
19.00	1	154	43.50	2.29	-9842	0	141	39.83	2.10	144000	3.67	0.8	1	122	32	9.04	19	5.37	3.67	1.8
19.50	1	155	43.79	2.25	-9911	6	147	41.53	2.13	139950	2.26	0.5	4	126	29	8.19	21	5.93	2.26	1.1
20.00	4	159	44.92	2.25	-9962	4	151	42.66	2.13	135000	2.26	0.5	4	130	29	8.19	21	5.93	2.26	1.1
20.50	4	163	46.05	2.25	-10017	1	152	42.94	2.09	131810	3.11	0.6	3	133	30	8.47	19	5.37	3.11	1.6
21.00	1	164	46.33	2.21	-10041	2	154	43.50	2.07	127500	2.82	0.6	2	135	29	8.19	19	5.37	2.82	1.4
21.50	3	167	47.18	2.19	-10091	4	158	44.63	2.08	123760	2.54	0.5	6	141	26	7.34	17	4.80	2.54	1.4
22.00	2	169	47.74	2.17	-10147	1	159	44.92	2.04	120000	2.82	0.6	2	143	26	7.34	16	4.52	2.82	1.5
22.50	3	172	48.59	2.16	-10193	1	160	45.20	2.01	118500	3.39	0.7	2	145	27	7.63	15	4.24	3.39	1.9
23.00	4	176	49.72	2.16	-10241	5	165	46.61	2.03	114504	3.11	0.6	6	151	25	7.06	14	3.95	3.11	1.8
23.50	2	178	50.28	2.14	-10294	2	167	47.18	2.01	111650	3.11	0.6	4	155	23	6.50	12	3.39	3.11	1.9
24.00	2	180	50.85	2.12	-10335	2	169	47.74	1.99	108120	3.11	0.6	1	156	24	6.78	13	3.67	3.11	1.8
24.50	1	181	51.13	2.09	-10373	3	172	48.59	1.98	105000	2.54	0.5	0	156	25	7.06	16	4.52	2.54	1.4
25.00	3	184	51.98	2.08	-10408	0	172	48.59	1.94	102400	3.39	0.6	2	158	26	7.34	14	3.95	3.39	1.9

* See LEGEND, Section C.3.

TABLE C-5 (cont.)

GPF01 DAT

CT

% Xing	TSC MODEL INC ACC	CUM #ACC	% ACC	POWER FACTR	HAZARD* INDEX	NEW HAMPSHIRE INC ACC	CUM #ACC	% ACC	POWER FACTR	HAZARD INDEX	WITH MATCH %DIFF	TVAL	INC MTCH	CUM MTCH	TSC LESS #ACC	MATCH % ACC	NH LESS #ACC	MATCH % ACC	LESS MATCH %DIFF	TVAL
25.50	1	185	52.26	2.05	-10448	3	175	49.44	1.94	100000	2.82	0.5	0	158	27	7.63	17	4.80	2.82	1.5
26.00	3	188	53.11	2.04	-10487	4	179	50.56	1.94	98064	2.54	0.5	1	159	29	8.19	20	5.65	2.54	1.3
26.50	2	190	53.67	2.03	-10519	0	179	50.56	1.91	96000	3.11	0.6	1	160	30	8.47	19	5.37	3.11	1.6
27.00	2	192	54.24	2.01	-10555	0	179	50.56	1.87	93500	3.67	0.7	1	161	31	8.76	18	5.08	3.67	1.9
27.50	0	192	54.24	1.97	-10597	6	185	52.26	1.90	90000	1.98	0.4	6	167	25	7.06	18	5.08	1.98	1.1
28.00	5	197	55.65	1.99	-10650	3	188	53.11	1.90	87696	2.54	0.5	3	170	27	7.63	18	5.09	2.54	1.3
28.50	1	198	55.93	1.96	-10695	1	189	53.39	1.87	86350	2.54	0.5	1	171	27	7.63	18	5.08	2.54	1.3
29.00	0	198	55.93	1.93	-10741	5	194	54.80	1.89	84000	1.13	0.2	3	174	24	6.78	20	5.65	1.13	0.6
29.50	3	201	56.78	1.92	-10786	0	194	54.80	1.86	82080	1.98	0.4	2	176	25	7.06	18	5.08	1.98	1.1
30.00	3	204	57.63	1.92	-10832	4	198	55.93	1.86	80000	1.69	0.3	3	179	25	7.06	19	5.37	1.69	0.9
30.50	1	205	57.91	1.90	-10856	0	198	55.93	1.83	79200	1.98	0.3	0	179	26	7.34	19	5.37	1.98	1.0
31.00	1	206	58.19	1.88	-10886	2	200	56.50	1.82	78200	1.69	0.3	1	180	26	7.34	20	5.65	1.69	0.9
31.50	1	207	58.47	1.86	-10932	0	200	56.50	1.79	75400	1.98	0.3	0	180	27	7.63	20	5.65	1.98	1.0
32.00	0	207	58.47	1.83	-10967	4	204	57.63	1.80	72100	0.85	0.1	2	182	25	7.06	22	6.21	0.85	0.4
32.50	1	208	58.76	1.81	-10982	7	211	59.60	1.83	71000	-0.85	-0.1	4	186	22	6.21	25	7.06	-0.85	-0.4
33.00	5	213	60.17	1.82	-11017	2	213	60.17	1.82	70000	0.00	0.0	3	189	24	6.78	24	6.78	0.00	0.0
33.50	6	219	61.86	1.85	-11052	2	215	60.73	1.81	68000	1.13	0.2	2	191	28	7.91	24	6.78	1.13	0.6
34.00	1	220	62.15	1.83	-11103	0	215	60.73	1.79	66000	1.41	0.2	1	192	28	7.91	23	6.50	1.41	0.7
34.50	3	223	62.99	1.83	-11137	1	216	61.02	1.77	64880	1.98	0.3	3	195	28	7.91	21	5.93	1.98	1.0
35.00	5	228	64.41	1.84	-11193	2	218	61.58	1.76	63250	2.82	0.5	1	196	32	9.04	22	6.21	2.82	1.4
35.50	1	229	64.69	1.82	-11218	3	221	62.43	1.76	62020	2.26	0.4	3	199	30	8.47	22	6.21	2.26	1.1
36.00	2	231	65.25	1.81	-11253	1	222	62.71	1.74	60600	2.54	0.4	1	200	31	8.76	22	6.21	2.50	1.2
36.50	1	232	65.54	1.80	-11303	0	222	62.71	1.72	60000	2.82	0.5	1	201	31	8.76	21	5.93	2.82	1.4
37.00	3	235	66.38	1.79	-11358	1	223	62.99	1.70	58104	3.39	0.6	2	203	32	9.04	20	5.65	3.39	1.7
37.50	5	240	67.80	1.81	-11397	6	229	64.69	1.73	56240	3.11	0.5	9	212	28	7.91	17	4.80	3.11	1.6
38.00	3	243	68.64	1.81	-11443	3	232	65.54	1.72	55000	3.11	0.5	3	215	28	7.91	17	4.80	3.11	1.6
38.50	2	245	69.21	1.80	-11477	4	236	66.67	1.73	54000	2.54	0.4	2	217	28	7.91	19	5.37	2.54	1.3
39.00	6	251	70.90	1.82	-11532	0	236	66.67	1.71	52500	4.24	0.7	2	219	32	9.04	17	4.80	4.24	2.1
39.50	1	252	71.19	1.80	-11556	0	236	66.67	1.69	51320	4.52	0.7	0	219	33	9.32	17	4.80	4.52	2.3
40.00	1	253	71.47	1.79	-11587	2	238	67.23	1.68	50040	4.24	0.7	1	220	33	9.32	18	5.08	4.24	2.1
40.50	4	257	72.60	1.79	-11633	1	239	67.51	1.67	49000	5.08	0.8	2	222	35	9.89	17	4.80	5.08	2.5
41.00	2	259	73.16	1.78	-11676	1	240	67.80	1.65	48000	5.37	0.9	1	223	36	10.17	17	4.80	5.37	2.6
41.50	1	260	73.45	1.77	-11706	1	241	68.08	1.64	47100	5.37	0.8	1	224	36	10.17	17	4.80	5.37	2.6
42.00	1	261	73.73	1.76	-11755	0	241	68.08	1.62	46000	5.65	0.9	0	224	37	10.45	17	4.80	5.65	2.7
42.50	1	262	74.01	1.74	-11779	3	244	68.93	1.62	45000	5.08	0.8	2	226	36	10.17	18	5.08	5.08	2.4
43.00	0	262	74.01	1.72	-11836	0	244	68.93	1.60	44000	5.08	0.8	0	226	36	10.17	18	5.08	5.08	2.4
43.50	2	264	74.58	1.71	-11877	1	245	69.21	1.59	42650	5.37	0.8	3	229	35	9.89	16	4.52	5.37	2.7
44.00	0	264	74.58	1.69	-11898	2	247	69.77	1.59	41280	4.80	0.8	1	230	34	9.60	17	4.80	4.80	2.4
44.50	3	267	75.42	1.69	-11945	2	249	70.34	1.58	40000	5.08	0.8	2	232	35	9.89	17	4.80	5.08	2.5
45.00	2	269	75.99	1.69	-11992	0	249	70.34	1.56	40000	5.65	0.9	0	232	37	10.45	17	4.80	5.65	2.7
45.50	2	271	76.55	1.68	-12030	2	251	70.90	1.56	39060	5.65	0.9	2	234	37	10.45	17	4.80	5.65	2.7
46.00	0	271	76.55	1.66	-12048	4	255	72.03	1.57	37800	4.52	0.7	4	238	33	9.32	17	4.80	4.52	2.3
46.50	2	273	77.12	1.66	-12087	1	256	72.32	1.56	37200	4.80	0.7	3	241	32	9.04	15	4.24	4.80	2.5
47.00	2	275	77.68	1.65	-12110	4	260	73.45	1.56	36160	4.24	0.6	4	245	30	8.47	15	4.24	4.24	2.2
47.50	3	278	78.53	1.65	-12158	1	261	73.73	1.55	36000	4.80	0.7	1	246	32	9.04	15	4.24	4.80	2.5
48.00	1	279	78.81	1.64	-12188	1	262	74.01	1.54	34450	4.80	0.7	1	247	32	9.04	15	4.24	4.80	2.5
48.50	2	281	79.38	1.64	-12204	2	264	74.58	1.54	33600	4.80	0.7	3	250	31	8.76	14	3.95	4.80	2.5
49.00	4	285	80.51	1.64	-12240	0	264	74.58	1.52	32500	5.93	0.9	2	252	33	9.32	12	3.39	5.93	3.1
49.50	0	285	80.51	1.63	-12276	0	264	74.58	1.51	32000	5.93	0.9	0	252	33	9.32	12	3.39	5.93	3.1
50.00	0	285	80.51	1.61	-12312	1	265	74.86	1.50	30800	5.65	0.9	0	252	33	9.32	13	3.67	5.65	2.9

*See LEGEND, Section C.3.

TABLE C-6. TSC (COMPREHENSIVE) VERSUS NEW HAMPSHIRE AUTOMATIC GATES

GPF10 DAT

% Xing	TSC MODEL INC ACC	TSC MODEL CUM #ACC	TSC MODEL % ACC	TSC MODEL POWER FACTR	TSC MODEL HAZARD INDEX*	NEW HAMPSHIRE CT INC ACC	NEW HAMPSHIRE CT CUM #ACC	NEW HAMPSHIRE CT % ACC	NEW HAMPSHIRE CT POWER FACTR	NEW HAMPSHIRE CT HAZARD INDEX	WITH MATCH %DIFF	WITH MATCH TVAL	INC MTCH	CUM MTCH	TSC LESS #ACC	TSC MATCH % ACC	NH LESS #ACC	NH MATCH % ACC	LESS MATCH %DIFF	LESS MATCH TVAL
0.50	10	10	2.82	5.65	-3964	7	7	1.98	3.95	1272000	0.85	0.7	6	6	4	1.13	1	0.28	0.85	1.3
1.00	5	15	4.24	4.24	-4745	7	14	3.95	3.95	939420	0.28	0.2	3	9	6	1.69	5	1.41	0.28	0.3
1.50	3	18	5.08	3.39	-5173	5	19	5.37	3.58	819360	-0.28	-0.2	2	11	7	1.98	8	2.26	-0.28	-0.3
2.00	10	28	7.91	3.95	-5728	5	24	6.78	3.39	748000	1.13	0.6	2	13	15	4.24	11	3.11	1.13	0.8
2.50	14	42	11.86	4.75	-6079	3	27	7.63	3.05	677660	4.24	1.8	4	17	25	7.06	10	2.82	4.24	2.5
3.00	2	44	12.43	4.14	-6324	8	35	9.89	3.30	593400	2.54	1.0	6	23	21	5.93	12	3.39	2.54	1.6
3.50	3	47	13.28	3.79	-6551	9	44	12.43	3.55	540000	0.85	0.3	6	29	18	5.08	15	4.24	0.85	0.5
4.00	3	50	14.12	3.53	-6780	2	46	12.99	3.25	488400	1.13	0.4	0	29	21	5.93	17	4.80	1.13	0.6
4.50	5	55	15.54	3.45	-6982	3	49	13.84	3.08	458080	1.69	0.6	2	31	24	6.78	18	5.08	1.69	0.9
5.00	4	59	16.67	3.33	-7181	0	49	13.84	2.77	425000	2.82	1.0	3	34	25	7.06	15	4.24	2.82	1.6
5.50	5	64	18.08	3.29	-7314	5	54	15.25	2.77	400320	2.82	0.9	6	40	24	6.78	14	3.95	2.82	1.6
6.00	2	66	18.64	3.11	-7411	11	65	18.36	3.06	373800	0.28	0.1	6	46	20	5.65	19	5.37	0.28	0.2
6.50	2	68	19.21	2.96	-7594	7	72	20.34	3.13	350000	-1.13	-0.3	2	48	20	5.65	24	6.78	-1.13	-0.6
7.00	4	72	20.34	2.91	-7731	5	77	21.75	3.11	334400	-1.41	-0.4	4	52	20	5.65	25	7.06	-1.41	-0.7
7.50	7	79	22.32	2.98	-7868	2	79	22.32	2.98	321600	0.00	0.0	4	56	23	6.50	23	6.50	0.00	0.0
8.00	4	83	23.45	2.93	-8009	4	83	23.45	2.93	308100	0.00	0.0	2	58	25	7.06	25	7.06	0.00	0.0
8.50	3	86	24.29	2.86	-8138	6	89	25.14	2.96	297600	-0.85	-0.2	4	62	24	6.78	27	7.63	-0.85	-0.4
9.00	3	89	25.14	2.79	-8280	1	90	25.42	2.82	285200	-0.28	-0.1	4	66	23	6.50	24	6.78	-0.28	-0.1
9.50	5	94	26.55	2.80	-8381	4	94	26.55	2.80	270100	0.00	0.0	5	71	23	6.50	23	6.50	0.00	0.0
10.00	1	95	26.84	2.68	-8506	2	96	27.12	2.71	261000	-0.28	-0.1	1	72	23	6.50	24	6.78	-0.28	-0.1
10.50	1	96	27.12	2.58	-8601	0	96	27.12	2.58	254400	0.00	0.0	0	72	24	6.78	24	6.78	0.00	0.0
11.00	2	98	27.68	2.52	-8676	0	96	27.12	2.47	246400	0.56	0.1	1	73	25	7.06	23	6.50	0.56	0.3
11.50	6	104	29.38	2.55	-8778	4	100	28.25	2.46	237000	1.13	0.3	6	79	25	7.06	21	5.93	1.13	0.6
12.00	2	106	29.94	2.50	-8860	4	104	29.38	2.45	228600	0.56	0.1	2	81	25	7.06	23	6.50	0.56	0.3
12.50	3	109	30.79	2.46	-8942	7	111	31.36	2.51	220000	-0.56	-0.1	1	82	27	7.63	29	8.19	-0.56	-0.3
13.00	3	112	31.64	2.43	-8994	2	113	31.92	2.46	210000	-0.28	-0.1	4	86	26	7.34	27	7.63	-0.28	-0.1
13.50	2	114	32.20	2.39	-9076	0	113	31.92	2.36	202800	0.28	0.1	2	88	26	7.34	25	7.06	0.28	0.1
14.00	5	119	33.62	2.40	-9120	2	115	32.49	2.32	197145	1.13	0.3	3	91	28	7.91	24	6.78	1.13	0.6
14.50	2	121	34.18	2.36	-9228	2	117	33.05	2.28	190400	1.13	0.3	2	93	28	7.91	24	6.78	1.13	0.6
15.00	7	128	36.16	2.41	-9318	5	122	34.46	2.30	183720	1.69	0.4	6	99	29	8.19	23	6.50	1.69	0.8
15.50	1	129	36.44	2.35	-9379	3	125	35.31	2.28	173600	1.13	0.3	3	102	27	7.63	23	6.50	1.13	0.6
16.00	1	130	36.72	2.30	-9426	2	127	35.88	2.24	170000	0.85	0.2	0	102	28	7.91	25	7.06	0.85	0.4
16.50	3	133	37.57	2.28	-9471	2	129	36.44	2.21	168000	1.13	0.2	1	103	30	8.47	26	7.34	1.13	0.5
17.00	3	136	38.42	2.26	-9556	3	132	37.29	2.19	161500	1.13	0.2	2	105	31	8.76	27	7.63	1.13	0.5
17.50	6	142	40.11	2.29	-9610	4	136	38.42	2.20	155800	1.69	0.4	5	110	32	9.04	26	7.34	1.69	0.8
18.00	3	145	40.96	2.28	-9690	3	139	39.27	2.18	150000	1.69	0.4	5	115	30	8.47	24	6.78	1.69	0.8
18.50	6	151	42.66	2.31	-9763	2	141	39.83	2.15	147400	2.82	0.6	5	120	31	8.76	21	5.93	2.82	1.4
19.00	5	156	44.07	2.32	-9865	0	141	39.83	2.10	144000	4.24	0.9	2	122	34	9.60	19	5.37	4.24	2.1
19.50	0	156	44.07	2.26	-9926	6	147	41.53	2.13	139950	2.54	0.5	1	123	33	9.32	24	6.78	2.54	1.2
20.00	5	161	45.48	2.27	-9982	4	151	42.66	2.13	135000	2.82	0.6	5	128	33	9.32	23	6.50	2.82	1.3
20.50	2	163	46.05	2.25	-10034	1	152	42.94	2.09	131810	3.11	0.6	3	131	32	9.04	21	5.93	3.11	1.5
21.00	2	165	46.61	2.22	-10080	2	154	43.50	2.07	127500	3.11	0.6	1	132	33	9.32	22	6.21	3.11	1.5
21.50	7	172	48.59	2.26	-10129	4	158	44.63	2.08	123760	3.95	0.8	6	138	34	9.60	20	5.65	3.95	1.9
22.00	3	175	49.44	2.25	-10161	1	159	44.92	2.04	120000	4.52	0.9	2	140	35	9.89	19	5.37	4.52	2.2
22.50	2	177	50.00	2.22	-10217	1	160	45.20	2.01	118500	4.80	0.9	3	143	34	9.60	17	4.80	4.80	2.4
23.00	4	181	51.13	2.22	-10283	5	165	46.61	2.03	114504	4.52	0.9	5	148	33	9.32	17	4.80	4.52	2.3
23.50	3	184	51.98	2.21	-10321	2	167	47.18	2.01	111650	4.80	0.9	3	151	33	9.32	16	4.52	4.80	2.4
24.00	1	185	52.26	2.18	-10395	2	169	47.74	1.99	108120	4.52	0.9	2	153	32	9.04	16	4.52	4.52	2.3
24.50	5	190	53.67	2.19	-10449	3	172	48.59	1.98	105000	5.08	0.9	2	155	35	9.89	17	4.80	5.08	2.5
25.00	1	191	53.95	2.16	-10495	0	172	48.59	1.94	102400	5.37	1.0	0	155	36	10.17	17	4.80	5.37	2.6

* See LEGEND, Section C.3.

TABLE C-6 (cont.)

GPF10 DAT

CT

% Xing	TSC MODEL INC ACC	CUM #ACC	% ACC	POWER FACTR	HAZARD* INDEX	NEW HAMPSHIRE INC ACC	CUM #ACC	% ACC	POWER FACTR	HAZARD INDEX	WITH MATCH %DIFF	TVAL	INC MTCH	CUM MTCH	TSC LESS MATCH #ACC	% ACC	NH LESS MATCH #ACC	% ACC	LESS MATCH %DIFF	TVAL
25.00	3	194	54.80	2.15	-10541	3	175	49.44	1.94	100000	5.37	1.0	0	155	39	11.02	20	5.65	5.37	2.5
26.00	3	197	55.65	2.14	-10574	4	179	50.56	1.94	98064	5.08	0.9	3	158	39	11.02	21	5.93	5.08	2.3
26.50	0	197	55.65	2.10	-10643	0	179	50.56	1.91	96000	5.08	0.9	0	158	39	11.02	21	5.93	5.08	2.3
27.00	2	199	56.21	2.08	-10687	0	179	50.56	1.87	93500	5.65	1.0	0	158	41	11.58	21	5.93	5.65	2.5
27.50	2	201	56.78	2.06	-10738	6	185	52.26	1.90	90000	4.52	0.8	5	163	38	10.73	22	6.21	4.52	2.1
28.00	1	202	57.06	2.04	-10786	3	188	53.11	1.90	87696	3.95	0.7	2	165	37	10.45	23	6.50	3.95	1.8
28.50	3	205	57.91	2.03	-10845	1	189	53.39	1.87	86350	4.52	0.8	2	167	38	10.73	22	6.21	4.52	2.1
29.00	1	206	58.19	2.01	-10877	5	194	54.80	1.89	84000	3.39	0.6	4	171	35	9.89	23	6.50	3.39	1.6
29.50	3	209	59.04	2.00	-10898	0	194	54.80	1.86	82080	4.24	0.7	1	172	37	10.45	22	6.21	4.24	2.0
30.00	6	215	60.73	2.02	-10944	4	198	55.93	1.86	80000	4.80	0.8	0	172	43	12.15	26	7.34	4.80	2.0
30.50	0	215	60.73	1.99	-10986	0	198	55.93	1.83	79200	4.80	0.8	0	172	43	12.15	26	7.34	4.80	2.0
31.00	6	221	62.43	2.01	-11048	2	200	56.50	1.82	78200	5.93	1.0	3	175	46	12.99	25	7.06	5.93	2.5
31.50	2	223	62.99	2.00	-11087	0	200	56.50	1.79	75400	6.50	1.1	1	176	47	13.28	24	6.78	6.50	2.7
32.00	1	224	63.28	1.98	-11134	4	204	57.63	1.80	72100	5.65	1.0	1	177	47	13.28	27	7.63	5.65	2.3
32.50	2	226	63.84	1.96	-11184	7	211	59.60	1.83	71000	4.24	0.7	8	185	41	11.58	26	7.34	4.24	1.8
33.00	2	228	64.41	1.95	-11240	2	213	60.17	1.82	70000	4.24	0.7	2	187	41	11.58	26	7.34	4.24	1.8
33.50	4	232	65.54	1.96	-11296	2	215	60.73	1.81	68000	4.80	0.8	0	187	45	12.71	28	7.91	4.80	2.0
34.00	1	233	65.82	1.94	-11323	0	215	60.73	1.79	66000	5.08	0.9	0	187	46	12.99	28	7.91	5.08	2.1
34.50	2	235	66.38	1.92	-11367	1	216	61.02	1.77	64880	5.37	0.9	3	190	45	12.71	26	7.34	5.37	2.3
35.00	3	238	67.23	1.92	-11423	2	218	61.58	1.76	63250	5.65	0.9	2	192	46	12.99	26	7.34	5.65	2.4
35.50	2	240	67.80	1.91	-11460	3	221	62.43	1.76	62020	5.37	0.9	4	196	44	12.43	25	7.06	5.37	2.3
36.00	0	240	67.80	1.88	-11499	1	222	62.71	1.74	60600	5.08	0.8	0	196	44	12.43	26	7.34	5.08	2.2
36.50	1	241	68.08	1.87	-11553	0	222	62.71	1.72	60000	5.37	0.9	1	197	44	12.43	25	7.06	5.37	2.3
37.00	1	242	68.36	1.85	-11596	1	223	62.99	1.70	58104	5.37	0.9	0	197	45	12.71	26	7.34	5.37	2.3
37.50	1	243	68.64	1.83	-11647	6	229	64.69	1.73	56240	3.95	0.6	7	204	39	11.02	25	7.06	3.95	1.8
38.00	1	244	68.93	1.81	-11672	3	232	65.54	1.72	55000	3.39	0.6	2	206	38	10.73	26	7.34	3.39	1.5
38.50	0	244	68.93	1.79	-11687	4	236	66.67	1.73	54000	2.26	0.4	2	208	36	10.17	28	7.91	2.26	1.0
39.00	1	245	69.21	1.77	-11725	0	236	66.67	1.71	52500	2.54	0.4	0	208	37	10.45	28	7.91	2.54	1.1
39.50	3	248	70.06	1.77	-11771	0	236	66.67	1.69	51320	3.39	0.5	1	209	39	11.02	27	7.63	3.39	1.5
40.00	0	248	70.06	1.75	-11793	2	238	67.23	1.68	50040	2.82	0.5	1	210	38	10.73	28	7.91	2.82	1.2
40.50	1	249	70.34	1.74	-11823	1	239	67.51	1.67	49000	2.82	0.5	2	212	37	10.45	27	7.63	2.82	1.3
41.00	1	250	70.62	1.72	-11863	1	240	67.80	1.65	48000	2.82	0.5	1	213	37	10.45	27	7.63	2.82	1.3
41.50	0	250	70.62	1.70	-11908	1	241	68.08	1.64	47100	2.54	0.4	1	214	36	10.17	27	7.63	2.54	1.1
42.00	0	250	70.62	1.68	-11939	0	241	68.08	1.62	46000	2.54	0.4	0	214	36	10.17	27	7.63	2.54	1.1
42.50	1	251	70.90	1.67	-11969	3	244	68.93	1.62	45000	1.98	0.3	1	215	36	10.17	29	8.19	1.98	0.9
43.00	1	252	71.19	1.66	-12000	0	244	68.93	1.60	44000	2.26	0.4	0	215	37	10.45	29	8.19	2.26	1.0
43.50	1	253	71.47	1.64	-12046	1	245	69.21	1.59	42650	2.26	0.4	1	216	37	10.45	29	8.19	2.26	1.0
44.00	1	254	71.75	1.63	-12077	2	247	69.77	1.59	41280	1.98	0.3	2	218	36	10.17	29	8.19	1.98	0.9
44.50	0	254	71.75	1.61	-12120	2	249	70.34	1.58	40000	1.41	0.2	0	218	36	10.17	31	8.76	1.41	0.6
45.00	0	254	71.75	1.59	-12142	0	249	70.34	1.56	40000	1.41	0.2	0	218	36	10.17	31	8.76	1.41	0.6
45.50	0	254	71.75	1.58	-12181	2	251	70.90	1.56	39060	0.85	0.1	1	219	35	9.89	32	9.04	0.85	0.4
46.00	1	255	72.03	1.57	-12220	4	255	72.03	1.57	37800	0.00	0.0	2	221	34	9.60	34	9.60	0.00	0.0
46.50	5	260	73.45	1.58	-12261	1	256	72.32	1.56	37200	1.13	0.2	4	225	35	9.89	31	8.76	1.13	0.5
47.00	2	262	74.01	1.57	-12306	4	260	73.45	1.56	36160	0.56	0.1	3	228	34	9.60	32	9.04	0.56	0.2
47.50	1	263	74.29	1.56	-12339	1	261	73.73	1.55	36000	0.56	0.1	1	229	34	9.60	32	9.04	0.56	0.2
48.00	1	264	74.58	1.55	-12384	1	262	74.01	1.54	34450	0.56	0.1	1	230	34	9.60	32	9.04	0.56	0.2
48.50	1	265	74.86	1.54	-12417	2	264	74.58	1.54	33600	0.28	0.0	2	232	33	9.32	32	9.04	0.28	0.1
49.00	1	266	75.14	1.53	-12468	0	264	74.58	1.52	32500	0.56	0.1	1	233	33	9.32	31	8.76	0.56	0.3
49.50	2	268	75.71	1.53	-12502	0	264	74.58	1.51	32000	1.13	0.2	2	235	33	9.32	29	8.19	1.13	0.5
50.00	2	270	76.27	1.53	-12548	1	265	74.86	1.50	30800	1.41	0.2	2	237	33	9.32	28	7.91	1.41	0.6

* See LEGEND, Section C.3.

TABLE C-7.* SPECIAL EOC AND POWER FACTORS FOR NEW HAMPSHIRE--FLASHING LIGHTS CASE FULL DATA BASE

% Xing	#ACC	% ACC	CT HAZ IND	PF	**.65	**.70	**.75	**.80	LOGLOG	LOGLOG	DELLN	DELLN	LNLN DELTA	DAT 7-AVE
0.50	120	4.53	464000	9.06	0.75	0.69	0.63	0.58	0.790	1.667	0.000	0.000	0.000	0.000
1.00	183	6.91	332000	6.91	0.72	0.66	0.61	0.57	0.659	1.527	0.131	0.140	0.937	0.000
1.50	233	8.79	267820	5.86	0.70	0.65	0.60	0.56	0.570	1.435	0.089	0.092	0.962	0.300
2.00	292	11.02	230400	5.51	0.70	0.66	0.61	0.57	0.534	1.364	0.036	0.071	0.503	0.000
2.50	347	13.09	205200	5.24	0.71	0.66	0.62	0.58	0.504	1.305	0.030	0.059	0.512	0.744
3.00	392	14.79	181300	4.93	0.71	0.66	0.62	0.58	0.467	1.255	0.037	0.051	0.733	0.715
3.50	438	16.53	165600	4.72	0.71	0.67	0.63	0.59	0.440	1.210	0.027	0.045	0.610	0.663
4.00	472	17.81	152688	4.45	0.70	0.66	0.62	0.59	0.401	1.169	0.039	0.041	0.950	0.607
4.50	510	19.25	140480	4.28	0.70	0.66	0.62	0.59	0.374	1.132	0.027	0.037	0.735	0.609
5.00	550	20.75	129540	4.15	0.70	0.66	0.63	0.59	0.353	1.097	0.021	0.035	0.601	0.591
5.50	602	22.72	121200	4.13	0.71	0.67	0.64	0.61	0.350	1.065	0.003	0.032	0.108	0.589
6.00	642	24.23	114520	4.04	0.71	0.68	0.64	0.61	0.333	1.034	0.016	0.030	0.529	0.502
6.50	679	25.62	108000	3.94	0.71	0.68	0.65	0.61	0.316	1.006	0.017	0.029	0.601	0.517
7.00	715	26.98	101500	3.85	0.71	0.68	0.65	0.62	0.300	0.978	0.016	0.027	0.600	0.548
7.50	757	28.57	96000	3.81	0.72	0.69	0.65	0.62	0.291	0.952	0.009	0.026	0.337	0.644
8.00	785	29.62	91040	3.70	0.72	0.68	0.65	0.62	0.269	0.927	0.021	0.025	0.845	0.687
8.50	813	30.68	86560	3.61	0.71	0.68	0.65	0.62	0.250	0.902	0.020	0.024	0.812	0.716
9.00	841	31.74	82500	3.53	0.71	0.68	0.65	0.62	0.231	0.879	0.018	0.023	0.781	0.760
9.50	867	32.72	79200	3.44	0.71	0.68	0.65	0.62	0.212	0.856	0.019	0.023	0.833	0.813
10.00	893	33.70	75400	3.37	0.71	0.68	0.65	0.62	0.195	0.834	0.018	0.022	0.805	0.738
10.50	916	34.57	72000	3.29	0.70	0.67	0.65	0.62	0.175	0.813	0.019	0.021	0.907	0.745
11.00	943	35.58	69749	3.23	0.70	0.67	0.65	0.62	0.160	0.792	0.015	0.021	0.708	0.744
11.50	979	36.94	66450	3.21	0.71	0.68	0.65	0.63	0.154	0.771	0.006	0.020	0.293	0.751
12.00	1001	37.77	64000	3.15	0.70	0.68	0.65	0.63	0.137	0.752	0.018	0.020	0.885	0.747
12.50	1025	38.68	61180	3.09	0.70	0.68	0.65	0.63	0.122	0.732	0.015	0.019	0.774	0.726
13.00	1046	39.47	60000	3.04	0.70	0.67	0.65	0.63	0.105	0.713	0.017	0.019	0.888	0.710
13.50	1069	40.34	56968	2.99	0.70	0.67	0.65	0.63	0.090	0.694	0.015	0.019	0.777	0.785
14.00	1092	41.21	54880	2.94	0.70	0.67	0.65	0.63	0.077	0.676	0.014	0.018	0.757	0.731
14.50	1118	42.19	52800	2.91	0.70	0.67	0.65	0.63	0.066	0.658	0.011	0.018	0.598	0.773
15.00	1139	42.98	50656	2.87	0.69	0.67	0.65	0.63	0.051	0.640	0.014	0.018	0.814	0.797
15.50	1166	44.00	49200	2.84	0.70	0.67	0.65	0.63	0.042	0.623	0.009	0.017	0.512	0.695
16.00	1181	44.57	48000	2.79	0.69	0.67	0.65	0.63	0.024	0.606	0.018	0.017	1.068	0.629
16.50	1196	45.13	46000	2.74	0.69	0.67	0.65	0.63	0.006	0.589	0.018	0.017	1.056	0.703
17.00	1231	46.45	44800	2.73	0.69	0.67	0.65	0.64	0.005	0.572	0.001	0.017	0.060	0.644
17.50	1248	47.09	43050	2.69	0.69	0.67	0.65	0.63	0.010	0.556	0.005	0.016	0.296	0.704
18.00	1261	47.58	41720	2.64	0.68	0.67	0.65	0.63	0.028	0.539	0.018	0.016	1.114	0.684
18.50	1288	48.60	40170	2.63	0.69	0.67	0.65	0.64	0.035	0.523	0.006	0.016	0.398	0.627
19.00	1304	49.21	39520	2.59	0.68	0.67	0.65	0.63	0.050	0.507	0.015	0.016	0.938	0.695
19.50	1320	49.81	38400	2.55	0.68	0.66	0.65	0.63	0.064	0.491	0.015	0.016	0.925	0.787
20.00	1341	50.60	37125	2.53	0.68	0.67	0.65	0.63	0.074	0.476	0.010	0.016	0.655	0.715
20.50	1364	51.47	36000	2.51	0.68	0.67	0.65	0.64	0.083	0.460	0.008	0.015	0.538	0.722
21.00	1379	52.04	35000	2.48	0.66	0.66	0.65	0.64	0.097	0.445	0.014	0.015	0.940	0.717
21.50	1400	52.83	34000	2.46	0.68	0.67	0.65	0.64	0.106	0.430	0.009	0.015	0.613	0.728
22.00	1424	53.74	33000	2.44	0.68	0.67	0.65	0.64	0.113	0.415	0.007	0.015	0.444	0.669
22.50	1439	54.30	32000	2.41	0.68	0.67	0.65	0.64	0.127	0.400	0.014	0.015	0.904	0.770
23.00	1452	54.79	31000	2.38	0.68	0.66	0.65	0.64	0.141	0.385	0.015	0.015	1.000	0.743
23.50	1479	55.81	30000	2.37	0.68	0.67	0.66	0.64	0.145	0.370	0.004	0.015	0.241	0.769
24.00	1487	56.11	29610	2.34	0.67	0.66	0.65	0.64	0.163	0.356	0.018	0.015	1.247	0.802
24.50	1504	56.75	28740	2.32	0.67	0.66	0.65	0.64	0.174	0.341	0.011	0.015	0.753	0.800
25.00	1520	57.36	28000	2.29	0.67	0.66	0.65	0.64	0.186	0.327	0.012	0.014	0.796	0.726

* See Subsection 4.1.5.

TABLE C-7* (cont.)

%			CT										LNLN DAT	
Xing	#ACC	% ACC	HAZ IND	PF	**.65	**.70	**.75	**.80	LOGLOG	LOGLOG	DELLN	DELLN	DELTA	7-AVE
25.50	1538	58.04	27000	2.28	0.67	0.66	0.65	0.64	0.196	0.312	0.010	0.014	0.675	0.816
26.00	1552	58.57	26250	2.25	0.67	0.66	0.65	0.64	0.208	0.298	0.013	0.014	0.885	0.736
26.50	1573	59.36	25500	2.24	0.67	0.66	0.65	0.64	0.215	0.284	0.007	0.014	0.487	0.863
27.00	1587	59.89	24800	2.22	0.67	0.66	0.65	0.64	0.227	0.270	0.012	0.014	0.865	[illegible]
27.50	1604	60.53	24000	2.20	0.67	0.66	0.65	0.64	0.237	0.255	0.010	0.014	0.688	0.900
28.00	1604	60.53	23800	2.16	0.66	0.65	0.64	0.64	0.260	0.241	0.023	0.014	1.644	0.862
28.50	1622	61.21	23000	2.15	0.66	0.65	0.64	0.64	0.269	0.227	0.009	0.014	0.608	0.903
29.00	1631	61.55	22400	2.12	0.66	0.65	0.64	0.63	0.284	0.213	0.016	0.014	1.121	0.920
29.50	1646	62.11	21800	2.11	0.65	0.65	0.64	0.63	0.295	0.199	0.011	0.014	0.763	0.961
30.00	1663	62.75	21168	2.09	0.65	0.65	0.64	0.64	0.304	0.186	0.009	0.014	0.636	0.881
30.50	1674	63.17	20800	2.07	0.65	0.65	0.64	0.63	0.317	0.172	0.014	0.014	0.981	0.941
31.00	1685	63.58	20070	2.05	0.65	0.64	0.64	0.63	0.331	0.158	0.013	0.014	0.974	0.908
31.50	1694	63.92	20000	2.03	0.64	0.64	0.64	0.63	0.346	0.144	0.015	0.014	1.088	0.855
32.00	1704	64.30	19500	2.01	0.64	0.64	0.63	0.63	0.360	0.131	0.014	0.014	1.022	0.845
32.50	1716	64.75	18986	1.99	0.64	0.64	0.63	0.63	0.372	0.117	0.012	0.014	0.893	0.900
33.00	1736	65.51	18400	1.99	0.64	0.64	0.63	0.63	0.377	0.103	0.005	0.014	0.391	0.875
33.50	1753	66.15	18000	1.97	0.64	0.64	0.64	0.63	0.385	0.089	0.008	0.014	0.567	0.814
34.00	1757	66.30	17790	1.95	0.64	0.63	0.63	0.63	0.404	0.076	0.019	0.014	1.363	0.789
34.50	1770	66.79	17200	1.94	0.63	0.63	0.63	0.63	0.415	0.062	0.011	0.014	0.799	0.754
35.00	1785	67.36	16800	1.92	0.63	0.63	0.63	0.63	0.424	0.049	0.009	0.014	0.665	0.826
35.50	1797	67.81	16316	1.91	0.63	0.63	0.63	0.63	0.435	0.035	0.011	0.014	0.845	1.821
36.00	1312	68.38	16000	1.90	0.63	0.63	0.63	0.63	0.444	0.021	0.009	0.014	0.648	1.724
36.50	1323	68.79	15600	1.88	0.63	0.63	0.63	0.63	0.456	0.008	0.012	0.014	0.893	1.746
37.00	1830	69.06	15200	1.87	0.63	0.63	0.63	0.63	0.472	0.006	0.016	0.002	7.533	1.773
37.50	1844	69.58	15000	1.86	0.63	0.63	0.63	0.63	0.481	0.019	0.009	0.014	0.687	1.719
38.00	1854	69.96	14484	1.84	0.62	0.62	0.63	0.63	0.494	0.033	0.013	0.014	0.938	1.702
38.50	1865	70.38	14108	1.83	0.62	0.62	0.62	0.63	0.505	0.047	0.012	0.014	0.867	1.741
39.00	1882	71.02	13878	1.82	0.62	0.63	0.63	0.63	0.512	0.060	0.006	0.014	0.468	0.766
39.50	1898	71.62	13500	1.81	0.62	0.63	0.63	0.63	0.519	0.074	0.007	0.014	0.525	0.796
40.00	1904	71.85	13120	1.80	0.62	0.62	0.63	0.63	0.535	0.087	0.016	0.014	1.171	0.796
40.50	1917	72.34	12800	1.79	0.62	0.62	0.63	0.63	0.545	0.101	0.010	0.014	0.706	0.889
41.00	1927	72.72	12448	1.77	0.62	0.62	0.62	0.63	0.557	0.115	0.012	0.014	0.897	0.985
41.50	1965	74.15	12000	1.79	0.63	0.64	0.64	0.64	0.544	0.128	0.013	0.014	0.938	1.052
42.00	1965	74.15	12000	1.77	0.62	0.63	0.63	0.64	0.565	0.142	0.021	0.014	1.521	1.008
42.50	1971	74.38	11712	1.75	0.62	0.62	0.63	0.63	0.580	0.156	0.016	0.014	1.134	1.068
43.00	1979	74.68	11400	1.74	0.62	0.62	0.63	0.63	0.594	0.170	0.014	0.014	0.999	1.004
43.50	1989	75.06	11000	1.73	0.61	0.62	0.63	0.63	0.606	0.183	0.012	0.014	0.862	0.932
44.00	1995	75.28	10740	1.71	0.61	0.62	0.62	0.63	0.622	0.197	0.016	0.014	1.125	0.758
44.50	2011	75.89	10450	1.71	0.61	0.62	0.63	0.63	0.628	0.211	0.006	0.014	0.446	0.800
45.00	2027	76.49	10164	1.70	0.61	0.62	0.63	0.64	0.634	0.225	0.006	0.014	0.439	0.790
45.50	2045	77.17	10000	1.70	0.62	0.62	0.63	0.64	0.638	0.239	0.004	0.014	0.299	0.788
46.00	2046	77.21	9852	1.68	0.61	0.62	0.63	0.63	0.658	0.253	0.020	0.014	1.428	0.694
46.50	2054	77.51	9600	1.67	0.61	0.62	0.62	0.63	0.671	0.267	0.013	0.014	0.958	0.668
47.00	2064	77.89	9360	1.66	0.61	0.61	0.62	0.63	0.683	0.281	0.011	0.014	0.817	0.747
47.50	2079	78.45	9120	1.65	0.61	0.62	0.63	0.64	0.690	0.295	0.007	0.014	0.470	0.827
48.00	2097	79.13	9000	1.65	0.61	0.62	0.63	0.64	0.693	0.309	0.004	0.014	0.261	0.705
48.50	2104	79.40	8800	1.64	0.61	0.62	0.63	0.64	0.707	0.324	0.014	0.014	0.996	0.748
49.00	2113	79.74	8520	1.63	0.61	0.62	0.63	0.64	0.720	0.338	0.012	0.014	0.856	0.000
49.50	2126	80.23	8340	1.62	0.61	0.62	0.63	0.64	0.728	0.352	0.008	0.014	0.578	0.000
50.00	2129	80.34	8050	1.61	0.60	0.61	0.62	0.64	0.746	0.367	0.018	0.014	1.254	0.000

* See Subsection 4.1.5.

TABLE C-8. COLEMAN-STEWART VERSUS NEW HAMPSHIRE CROSSBUCKS

	COLEMAN-STEWART					NEW HAMPSHIRE				CT					CS		NH			
% Xing	INC ACC	CUM #ACC	% ACC	POWER FACTR	HAZARD INDEX	INC ACC	CUM #ACC	% ACC	POWER FACTR	HAZARD INDEX	WITH MATCH ZDIFF	TVAL	INC MTCH	CUM MTCH	LESS MATCH #ACC	% ACC	LESS MATCH #ACC	% ACC	LESS MATCH ZDIFF	TVAL
0.50	81	81	4.08	8.17	-55606	83	83	4.18	8.37	72000	-0.10	-0.2	61	61	20	1.01	22	1.11	-0.10	-0.3
1.00	62	143	7.21	7.21	-65998	52	135	6.80	6.80	47300	0.40	0.5	41	102	41	2.07	33	1.66	0.40	0.9
1.50	44	187	9.43	6.28	-71172	54	189	9.53	6.35	34500	-0.10	-0.1	36	138	49	2.47	51	2.57	-0.10	-0.2
2.00	47	234	11.79	5.90	-75656	56	245	12.35	6.17	27700	-0.55	-0.5	40	178	56	2.82	67	3.38	-0.55	-1.0
2.50	60	294	14.31	5.73	-78853	56	301	15.17	6.07	22800	-0.86	-0.7	42	220	64	3.23	81	4.08	-0.86	-1.4
3.00	32	326	16.43	5.48	-81572	40	341	17.19	5.73	19200	-0.76	-0.6	39	259	67	3.38	82	4.13	-0.76	-1.2
3.50	50	376	18.95	5.41	-84941	34	375	18.90	5.40	16900	0.05	0.0	28	287	89	4.49	88	4.44	0.05	0.1
4.00	37	413	20.82	5.20	-87191	41	416	20.97	5.24	14800	-0.15	-0.1	35	322	91	4.59	94	4.74	-0.15	-0.2
4.50	30	443	22.33	4.96	-89405	45	461	23.24	5.16	13300	-0.91	-0.6	35	357	86	4.33	104	5.24	-0.91	-1.3
5.00	40	483	24.34	4.87	-91324	33	494	24.90	4.98	12000	-0.55	-0.4	38	395	88	4.44	99	4.99	-0.55	-0.8
5.50	36	519	26.16	4.76	-93286	31	525	26.46	4.81	11000	-0.30	-0.2	37	432	87	4.39	93	4.69	-0.30	-0.4
6.00	41	560	28.23	4.70	-94932	42	567	28.58	4.76	10000	-0.35	-0.2	36	468	92	4.64	99	4.99	-0.35	-0.5
6.50	29	589	29.69	4.57	-96432	24	591	29.79	4.58	9150	-0.10	-0.1	37	505	84	4.23	86	4.33	-0.10	-0.2
7.00	32	621	31.30	4.47	-97840	24	615	31.00	4.43	8500	0.30	0.2	32	537	84	4.23	78	3.93	0.30	0.5
7.50	21	642	32.36	4.31	-99324	23	638	32.16	4.29	8000	0.20	0.1	24	561	81	4.08	77	3.88	0.20	0.3
8.00	24	666	33.57	4.20	-100628	27	665	33.52	4.19	7484	0.05	0.0	23	584	82	4.13	81	4.08	0.05	0.1
8.50	23	689	34.73	4.09	-102035	23	688	34.68	4.08	6900	0.05	0.0	18	602	87	4.39	86	4.33	0.05	0.1
9.00	22	711	35.84	3.98	-103475	22	710	35.79	3.98	6400	0.05	0.0	22	624	87	4.39	86	4.33	0.05	0.1
9.50	20	731	36.84	3.88	-104734	26	736	37.10	3.90	6000	-0.25	-0.1	19	643	88	4.44	93	4.69	-0.25	-0.4
10.00	21	752	37.90	3.79	-105566	23	759	38.26	3.83	5600	-0.35	-0.2	22	665	87	4.39	94	4.74	-0.35	-0.5
10.50	22	774	39.01	3.72	-106599	31	790	39.82	3.79	5250	-0.81	-0.4	19	684	90	4.54	106	5.34	-0.81	-1.1
11.00	22	796	40.12	3.65	-107706	27	817	41.18	3.74	5000	-1.06	-0.5	29	713	83	4.18	104	5.24	-1.06	-1.5
11.50	20	816	41.13	3.58	-108840	22	839	42.29	3.68	4900	-1.16	-0.6	22	735	81	4.08	104	5.24	-1.16	-1.7
12.00	22	838	42.24	3.52	-109721	30	869	43.80	3.65	4400	-1.56	-0.8	30	765	73	3.68	104	5.24	-1.56	-2.3
12.50	25	863	43.50	3.48	-110853	22	891	44.91	3.59	4200	-1.41	-0.7	21	786	77	3.88	105	5.29	-1.41	-2.1
13.00	24	887	44.71	3.44	-111849	36	927	46.72	3.59	4000	-2.02	-0.9	30	816	71	3.58	111	5.59	-2.02	-3.0
13.50	19	906	45.67	3.38	-112743	13	940	47.38	3.51	3800	-1.71	-0.8	21	837	69	3.48	103	5.19	-1.71	-2.6
14.00	9	914	46.07	3.29	-113368	17	957	48.24	3.45	3600	-2.17	-1.0	9	846	68	3.43	111	5.59	-2.17	-3.2
14.50	20	934	47.08	3.25	-114378	8	965	48.64	3.35	3500	-1.56	-0.7	18	864	70	3.53	101	5.09	-1.56	-2.4
15.00	13	947	47.73	3.18	-115421	23	988	49.80	3.32	3240	-2.07	-0.9	20	884	63	3.18	104	5.24	-2.07	-3.2
15.50	14	961	48.44	3.13	-116134	15	1003	50.55	3.26	3070	-2.12	-0.9	13	897	64	3.23	106	5.34	-2.12	-3.2
16.00	13	974	49.09	3.07	-116945	31	1034	52.12	3.26	3000	-3.02	-1.3	23	920	54	2.72	114	5.75	-3.02	-4.6
16.50	13	987	49.75	3.02	-117549	1	1035	52.17	3.16	2948	-2.42	-1.1	10	930	57	2.87	105	5.29	-2.42	-3.8
17.00	18	1005	50.66	2.98	-118383	19	1054	53.13	3.13	2800	-2.47	-1.1	16	946	59	2.97	108	5.44	-2.47	-3.8
17.50	20	1025	51.66	2.95	-118949	21	1075	54.18	3.10	2600	-2.52	-1.1	18	964	61	3.07	111	5.59	-2.52	-3.8
18.00	16	1041	52.47	2.91	-119536	15	1090	54.94	3.05	2500	-2.47	-1.1	11	975	66	3.33	115	5.80	-2.47	-3.6
18.50	19	1060	53.43	2.89	-120447	23	1113	56.10	3.03	2400	-2.67	-1.1	25	1000	60	3.02	113	5.70	-2.67	-4.0
19.00	10	1070	53.93	2.84	-121082	0	1113	56.10	2.95	2400	-2.17	-0.9	9	1009	61	3.07	104	5.24	-2.17	-3.3
19.50	17	1087	54.79	2.81	-121916	17	1130	56.96	2.92	2240	-2.17	-0.9	21	1030	57	2.87	100	5.04	-2.17	-3.4
20.00	12	1099	55.39	2.77	-122625	12	1142	57.56	2.88	2130	-2.17	-0.9	10	1040	59	2.97	102	5.14	-2.17	-3.4
20.50	19	1118	56.35	2.75	-123505	45	1187	59.83	2.92	2000	-3.48	-1.4	34	1074	44	2.22	113	5.70	-3.48	-5.5
21.00	13	1131	57.01	2.71	-124047	0	1187	59.83	2.85	2000	-2.82	-1.2	7	1081	50	2.52	106	5.34	-2.62	-4.5
21.50	7	1138	57.36	2.67	-124490	0	1187	59.83	2.78	2000	-2.47	-1.0	4	1085	53	2.67	102	5.14	-2.47	-3.9
22.00	14	1152	58.06	2.64	-125310	8	1195	60.23	2.74	1900	-2.17	-0.9	15	1100	52	2.62	95	4.79	-2.17	-3.5
22.50	14	1166	58.77	2.61	-126045	22	1217	61.34	2.73	1800	-2.57	-1.0	19	1119	47	2.37	98	4.94	-2.57	-4.2
23.00	17	1183	59.63	2.59	-126892	11	1228	61.90	2.69	1750	-2.27	-0.9	13	1132	51	2.57	96	4.84	-2.27	-3.7
23.50	18	1201	60.53	2.58	-127554	14	1242	62.60	2.66	1620	-2.07	-0.8	12	1144	57	2.87	98	4.94	-2.07	-3.3
24.00	15	1216	61.29	2.55	-128421	18	1260	63.51	2.65	1600	-2.22	-0.9	20	1164	52	2.62	96	4.84	-2.22	-3.6
24.50	12	1228	61.90	2.53	-129052	10	1270	64.01	2.61	1520	-2.12	-0.8	13	1177	51	2.57	93	4.69	-2.12	-3.5
25.00	23	1251	63.05	2.52	-129599	25	1295	65.27	2.61	1500	-2.22	-0.9	29	1206	45	2.27	89	4.49	-2.22	-3.8

TABLE C-8 (cont.)

% Xing	COLEMAN-STEWART INC ACC	CUM #ACC	% ACC	POWER FACTR HAZARD INDEX	NEW HAMPSHIRE INC ACC	CUM #ACC	% ACC	POWER FACTR	CT HAZARD INDEX	WITH MATCH %DIFF	TVAL	INC MTCH	CUM MTCH	CS LESS #ACC	MATCH % ACC	NH LESS #ACC	MATCH % ACC	LESS MATCH %DIFF	TVAL
25.50	21	1272	64.11	2.51-130259	1	1296	65.32	2.56	1460	-1.21	-0.5	16	1222	50	2.52	74	3.73	-1.21	-2.2
26.00	12	1284	64.72	2.49-130984	15	1311	66.08	2.54	1400	-1.36	-0.5	18	1240	44	2.22	71	3.58	-1.36	-2.5
26.50	13	1297	65.37	2.47-131601	6	1317	66.39	2.50	1350	-1.01	-0.4	12	1252	45	2.27	65	3.28	-1.01	-1.9
27.00	12	1309	65.98	2.44-132317	9	1326	66.83	2.48	1280	-0.86	-0.3	11	1263	46	2.32	63	3.18	-0.86	-1.6
27.50	11	1320	66.53	2.42-132947	8	1334	67.24	2.45	1220	-0.71	-0.3	10	1273	47	2.37	61	3.07	-0.71	-1.3
28.00	7	1327	66.89	2.39-133349	30	1364	68.75	2.46	1200	-1.86	-0.7	16	1289	38	1.92	75	3.78	-1.86	-3.5
28.50	13	1340	67.54	2.37-134216	0	1364	68.75	2.41	1200	-1.21	-0.5	6	1295	45	2.27	69	3.48	-1.21	-2.2
29.00	17	1357	68.40	2.36-134843	13	1377	69.41	2.39	1120	-1.01	-0.4	20	1315	42	2.12	62	3.13	-1.01	-2.0
29.50	13	1370	69.05	2.34-135464	13	1390	70.06	2.37	1080	-1.01	-0.4	11	1326	44	2.22	64	3.23	-1.01	-1.9
30.00	9	1379	69.51	2.32-136307	11	1401	70.61	2.35	1020	-1.11	-0.4	7	1333	46	2.32	68	3.43	-1.11	-2.1
30.50	5	1384	69.76	2.29-136965	37	1438	72.48	2.28	1000	-2.72	-1.0	17	1350	34	1.71	88	4.44	-2.72	-4.9
31.00	15	1399	70.51	2.27-137425	0	1438	72.48	2.34	1000	-1.97	-0.7	10	1360	39	1.97	78	3.93	-1.97	-3.6
31.50	12	1411	71.12	2.25-138019	0	1438	72.48	2.30	1000	-1.36	-0.5	9	1369	42	2.12	69	3.48	-1.36	-2.6
32.00	3	1414	71.27	2.23-138162	19	1457	73.44	2.29	925	-2.17	-0.8	9	1378	36	1.81	79	3.98	-2.17	-4.0
32.50	8	1422	71.67	2.21-138511	19	1476	74.40	2.29	900	-2.72	-1.0	11	1389	33	1.66	87	4.39	-2.72	-4.9
33.00	12	1434	72.28	2.19-139450	1	1477	74.45	2.26	890	-2.17	-0.8	8	1397	37	1.86	80	4.03	-2.17	-4.0
33.50	9	1443	72.73	2.17-139965	12	1489	75.05	2.24	840	-2.32	-0.8	13	1410	33	1.66	79	3.98	-2.32	-4.3
34.00	10	1453	73.24	2.15-140674	27	1516	76.41	2.25	800	-3.18	-1.2	15	1425	28	1.41	91	4.59	-3.18	-5.8
34.50	13	1466	73.89	2.14-141392	0	1516	76.41	2.21	800	-2.52	-0.9	9	1434	32	1.61	82	4.13	-2.52	-4.7
35.00	11	1477	74.45	2.12-141887	3	1519	76.56	2.19	775	-2.12	-0.8	9	1443	34	1.71	76	3.83	-2.12	-4.0
35.50	10	1487	74.95	2.11-142337	9	1528	77.02	2.17	750	-2.07	-0.7	12	1455	32	1.61	73	3.68	-2.07	-4.0
36.00	9	1496	75.40	2.09-142820	17	1545	77.87	2.16	720	-2.47	-0.9	12	1467	29	1.46	78	3.93	-2.47	-4.7
36.50	9	1505	75.86	2.08-143437	7	1552	78.23	2.14	700	-2.37	-0.9	9	1476	29	1.46	76	3.83	-2.37	-4.6
37.00	16	1521	76.66	2.07-144152	5	1557	78.48	2.12	660	-1.81	-0.6	14	1490	31	1.56	67	3.38	-1.81	-3.6
37.50	13	1534	77.32	2.06-144377	7	1564	78.83	2.10	640	-1.51	-0.5	10	1500	34	1.71	64	3.23	-1.51	-3.0
38.00	9	1543	77.77	2.05-145267	37	1601	80.70	2.12	600	-2.92	-1.0	16	1516	27	1.36	85	4.28	-2.92	-5.5
38.50	12	1555	78.38	2.04-145768	0	1601	80.70	2.10	600	-2.32	-0.8	11	1527	28	1.41	74	3.73	-2.32	-4.6
39.00	11	1566	78.93	2.02-146482	0	1601	80.70	2.07	600	-1.76	-0.6	9	1536	30	1.51	65	3.28	-1.76	-3.6
39.50	7	1573	79.28	2.01-146950	0	1601	80.70	2.04	594	-1.41	-0.5	7	1543	30	1.51	58	2.92	-1.41	-3.0
40.00	14	1587	79.99	2.00-147772	11	1612	81.25	2.03	550	-1.26	-0.4	9	1552	35	1.76	60	3.02	-1.26	-2.6
40.50	3	1590	80.14	1.98-148351	6	1618	81.55	2.01	572	-1.41	-0.5	7	1559	31	1.56	59	2.97	-1.41	-3.0
41.00	6	1596	80.44	1.96-149010	23	1641	82.71	2.02	500	-2.27	-0.8	7	1566	30	1.51	75	3.78	-2.27	-4.4
41.50	5	1601	80.70	1.94-149290	0	1641	82.71	1.99	500	-2.02	-0.7	3	1569	32	1.61	72	3.63	-2.02	-3.9
42.00	2	1603	80.80	1.92-149939	0	1641	82.71	1.97	500	-1.92	-0.7	2	1571	32	1.61	70	3.53	-1.92	-3.8
42.50	8	1611	81.20	1.91-150520	0	1641	82.71	1.95	500	-1.51	-0.5	4	1575	36	1.81	66	3.33	-1.51	-3.0
43.00	6	1617	81.50	1.90-151020	7	1648	83.06	1.93	480	-1.56	-0.5	9	1584	33	1.66	64	3.23	-1.56	-3.1
43.50	14	1631	82.21	1.89-151577	4	1652	83.27	1.91	460	-1.06	-0.4	11	1595	36	1.81	57	2.87	-1.06	-2.2
44.00	5	1636	82.46	1.87-152317	9	1661	83.72	1.90	450	-1.26	-0.4	5	1600	36	1.81	61	3.07	-1.26	-2.5
44.50	10	1646	82.96	1.86-153034	7	1668	84.07	1.89	420	-1.11	-0.4	9	1609	37	1.86	59	2.97	-1.11	-2.2
45.00	9	1655	83.42	1.85-153482	23	1691	85.23	1.89	400	-1.81	-0.6	17	1626	29	1.46	65	3.28	-1.81	-3.7
45.50	11	1666	83.97	1.85-153978	0	1691	85.23	1.87	400	-1.26	-0.4	11	1637	29	1.46	54	2.72	-1.26	-2.7
46.00	2	1668	84.07	1.83-154178	0	1691	85.23	1.85	400	-1.16	-0.4	2	1639	29	1.46	52	2.62	-1.16	-2.6
46.50	4	1672	84.27	1.81-154889	0	1691	85.23	1.83	400	-0.96	-0.3	4	1643	29	1.46	48	2.42	-0.96	-2.2
47.00	13	1685	84.93	1.81-155599	1	1692	85.28	1.81	376	-0.35	-0.1	13	1656	29	1.46	36	1.81	-0.35	-0.9
47.50	2	1687	85.03	1.79-156143	7	1699	85.64	1.80	360	-0.60	-0.2	4	1660	27	1.36	39	1.97	-0.60	-1.5
48.00	5	1692	85.28	1.78-156751	0	1699	85.64	1.78	350	-0.35	-0.1	3	1663	29	1.46	36	1.81	-0.35	-0.9
48.50	8	1700	85.69	1.77-156918	5	1704	85.89	1.77	326	-0.20	-0.1	9	1672	28	1.41	32	1.61	-0.20	-0.5
49.00	4	1704	85.89	1.75-157248	5	1709	86.14	1.76	320	-0.25	-0.1	6	1678	26	1.31	31	1.56	-0.25	-0.7
49.50	7	1711	86.24	1.74-157359	14	1723	86.84	1.75	300	-0.60	-0.2	8	1686	25	1.26	37	1.86	-0.60	-1.5
50.00	3	1714	86.39	1.73-157915	0	1723	86.84	1.74	300	-0.45	-0.2	3	1689	25	1.26	34	1.71	-0.45	-1.2

TABLE C-9. COLEMAN-STEWART VERSUS NEW HAMPSHIRE FLASHING LIGHTS

% Xing	COLEMAN-STEWART INC ACC	CUM ACC	% ACC	POWER FACTOR	HAZARD INDEX	NEW HAMPSHIRE INC ACC	CUM ACC	% ACC	POWER FACTOR	CT HAZARD INDEX	WITH MATCH %DIFF	TVAL	INC MTCH	CUM MTCH	CS LESS #ACC	MATCH % ACC	NH LESS #ACC	MATCH % ACC	LESS MATCH %DIFF	TVAL
0.50	57	57	4.31	7.85	-21164	55	55	4.15	3.31	487800	-0.23	-0.3	40	40	12	0.91	15	1.13	-0.23	-0.6
1.00	33	90	6.80	6.90	-27457	34	89	6.72	6.72	327790	0.08	0.1	24	64	26	1.96	25	1.89	0.08	0.1
1.50	23	113	8.53	5.60	-31437	26	115	8.68	5.79	268380	-0.15	-0.1	20	84	29	2.19	31	2.34	-0.15	-0.3
2.00	23	136	10.27	5.14	-34461	29	144	10.87	5.44	234000	-0.60	-0.5	19	103	33	2.49	41	3.10	-0.60	-0.9
2.50	19	155	11.71	4.68	-37924	25	169	12.76	5.11	210000	-1.06	-0.8	18	121	34	2.57	48	3.63	-1.06	-1.5
3.00	21	176	13.29	4.93	-40577	29	198	14.95	4.98	183320	-1.66	-1.1	13	134	42	3.17	64	4.83	-1.66	-2.1
3.50	29	205	15.48	4.47	-43019	19	217	16.39	4.58	169400	-0.91	-0.6	15	149	56	4.23	68	5.14	-0.91	-1.1
4.00	20	225	16.99	4.25	-45179	14	231	17.45	4.36	153038	-0.45	-0.3	7	156	69	5.21	75	5.66	-0.45	-0.5
4.50	13	238	17.98	3.99	-46682	19	250	18.88	4.20	139000	-0.91	-0.5	15	171	67	5.06	79	5.97	-0.91	-1.0
5.00	11	249	18.81	3.76	-48357	23	273	20.62	4.12	128000	-1.81	-1.1	12	183	66	4.98	90	6.80	-1.81	-1.9
5.50	26	275	20.77	3.78	-50160	23	296	22.36	4.06	120900	-1.59	-0.9	18	201	74	5.59	95	7.18	-1.59	-1.6
6.00	24	299	22.58	3.76	-51750	26	322	24.32	4.05	112720	-1.74	-0.9	22	223	76	5.74	99	7.48	-1.74	-1.7
6.50	11	310	23.41	3.60	-53090	18	340	25.68	3.95	106981	-2.27	-1.2	9	232	78	5.89	108	8.16	-2.27	-2.2
7.00	17	327	24.70	3.53	-54438	24	364	27.49	3.93	100000	-2.79	-1.4	19	251	76	5.74	113	8.53	-2.79	-2.7
7.50	14	341	25.76	3.43	-55920	15	379	28.63	3.82	94560	-2.87	-1.4	14	265	76	5.74	114	8.61	-2.87	-2.8
8.00	17	358	27.04	3.34	-57056	18	397	29.98	3.75	90000	-2.95	-1.4	12	277	81	6.12	120	9.06	-2.95	-2.8
8.50	29	387	29.23	3.44	-58218	10	407	30.74	3.62	85400	-1.51	-0.7	18	295	92	6.95	112	8.46	-1.51	-1.4
9.00	4	391	29.53	3.28	-59156	15	422	31.87	3.54	81700	-2.34	-1.1	8	303	88	6.65	119	8.99	-2.34	-2.2
9.50	16	407	30.74	3.24	-60326	6	428	32.33	3.40	78880	-1.59	-0.7	12	315	92	6.95	113	8.53	-1.59	-1.5
10.00	16	423	31.95	3.19	-61028	12	440	33.23	3.32	75600	-1.28	-0.6	18	333	90	6.80	107	8.08	-1.28	-1.2
10.50	20	443	33.46	3.19	-61964	14	454	34.29	3.27	72000	-0.83	-0.4	24	357	86	6.50	97	7.33	-0.83	-0.8
11.00	22	465	35.12	3.19	-62767	18	472	35.65	3.24	69225	-0.53	-0.2	22	379	86	6.50	93	7.02	-0.53	-0.5
11.50	15	480	36.25	3.15	-63470	20	492	37.16	3.23	66000	-0.91	-0.4	17	396	84	6.34	96	7.25	-0.91	-0.9
12.00	18	498	37.61	3.13	-64427	12	504	38.07	3.17	64000	-0.45	-0.2	15	411	87	6.57	93	7.02	-0.45	-0.4
12.50	19	517	39.05	3.12	-65235	11	515	38.90	3.11	61088	0.15	0.1	16	427	90	6.80	88	6.65	0.15	0.1
13.00	11	528	39.88	3.07	-65870	8	523	39.50	3.04	59300	0.38	0.2	8	435	93	7.02	88	6.65	0.38	0.4
13.50	13	541	40.86	3.03	-66646	8	531	40.11	2.97	56480	0.76	0.3	10	445	96	7.25	86	6.50	0.76	0.7
14.00	10	551	41.62	2.97	-67289	16	547	41.31	2.95	54000	0.30	0.1	11	456	95	7.18	91	6.87	0.30	0.3
14.50	13	564	42.60	2.94	-67997	15	562	42.45	2.93	51500	0.15	0.1	16	472	92	6.95	90	6.80	0.15	0.1
15.00	10	574	43.35	2.89	-68676	9	571	43.13	2.88	49940	0.23	0.1	10	482	92	6.95	89	6.72	0.23	0.2
15.50	12	586	44.26	2.86	-69330	12	583	44.03	2.84	48000	0.23	0.1	13	495	91	6.87	88	6.65	0.23	0.2
16.00	18	604	45.62	2.85	-69962	5	588	44.41	2.78	46554	1.21	0.5	13	508	96	7.25	80	6.04	1.21	1.2
16.50	13	617	46.60	2.82	-70679	22	610	46.07	2.79	45000	0.53	0.2	22	530	87	6.57	80	6.04	0.53	0.5
17.00	13	630	47.58	2.77	-71431	6	616	46.53	2.74	43260	1.06	0.4	11	541	89	6.72	75	5.66	1.06	1.1
17.50	6	636	48.04	2.74	-72025	7	623	47.05	2.69	41990	0.98	0.4	9	550	86	6.50	73	5.51	0.98	1.0
18.00	7	643	48.56	2.70	-72697	17	640	48.34	2.69	40390	0.23	0.1	14	564	79	5.97	76	5.74	0.23	0.2
18.50	14	657	49.62	2.68	-73277	8	648	48.94	2.65	40000	0.68	0.2	14	578	79	5.97	70	5.29	0.68	0.7
19.00	10	667	50.38	2.65	-74080	8	656	49.55	2.61	38800	0.83	0.3	7	585	82	6.19	71	5.36	0.83	0.9
19.50	4	671	50.68	2.60	-74669	13	669	50.53	2.59	37500	0.15	0.1	12	597	74	5.59	72	5.44	0.15	0.2
20.00	5	676	51.06	2.55	-75417	17	686	51.81	2.59	36000	-0.76	-0.3	8	605	71	5.36	81	6.12	-0.76	-0.8
20.50	7	683	51.59	2.52	-75359	6	692	52.27	2.55	35000	-0.68	-0.2	8	613	70	5.29	79	5.97	-0.68	-0.7
21.00	8	691	52.19	2.49	-76477	8	700	52.87	2.52	34000	-0.68	-0.2	8	621	70	5.29	79	5.97	-0.68	-0.7
21.50	14	705	53.25	2.49	-77349	9	709	53.55	2.49	33000	-0.30	-0.1	13	634	71	5.36	75	5.66	-0.30	-0.3
22.00	13	718	54.23	2.46	-77739	6	715	54.00	2.45	32000	0.23	0.1	7	641	77	5.82	74	5.59	0.23	0.2
22.50	12	730	55.14	2.45	-78196	7	722	54.53	2.42	30940	0.60	0.2	9	650	80	6.04	72	5.44	0.60	0.6
23.00	4	734	55.44	2.41	-78721	9	731	55.21	2.40	30000	0.23	0.1	6	656	78	5.89	75	5.66	0.23	0.2
23.50	5	739	55.82	2.38	-79326	4	735	55.51	2.36	29700	0.30	0.1	7	663	76	5.74	72	5.44	0.30	0.3
24.00	7	746	56.34	2.35	-79928	9	744	56.19	2.34	28800	0.15	0.1	8	671	75	5.66	73	5.51	0.15	0.2
24.50	7	753	56.87	2.32	-80393	9	753	56.87	2.32	28000	0.00	0.0	7	678	75	5.66	75	5.66	0.00	0.0
25.00	11	764	57.70	2.31	-80954	9	762	57.55	2.30	27000	0.15	0.1	12	690	74	5.59	72	5.44	0.15	0.2

TABLE C-9 (cont.)

% Xing	COLEMAN-STEWART INC ACC	CUM SACC	% ACC	POWER FACTR	HAZARD INDEX	NEW HAMPSHIRE INC ACC	CUM SACC	% ACC	POWER FACTR	HAZARD INDEX	CT WITH MATCH DIFF	TVAL	INC MTCH	CUM MTCH	CS LESS MATCH #ACC	% ACC	NH LESS MATCH #ACC	% ACC	LESS MATCH DIFF	TVAL
25.50	10	774	58.46	2.29	-81652	7	769	58.08	2.28	26470	0.38	0.1	4	698	76	5.74	71	5.36	0.38	0.4
26.00	9	783	59.14	2.27	-82346	13	782	59.05	2.27	25600	0.06	0.0	7	705	78	5.89	77	5.81	0.08	0.1
26.50	4	787	59.44	2.24	-82976	7	789	59.50	2.25	25000	-0.15	-0.1	8	713	74	5.59	76	5.73	-0.15	-0.2
27.00	9	796	60.12	2.23	-83525	6	795	60.05	2.22	24200	0.08	0.0	8	721	75	5.66	74	5.59	0.08	0.1
27.50	7	803	60.65	2.21	-84017	5	800	60.42	2.20	24000	0.23	0.1	4	725	74	5.59	71	5.36	0.23	0.2
28.00	11	814	61.48	2.20	-84541	5	805	60.80	2.17	23200	0.68	0.2	6	735	79	5.97	70	5.29	0.68	0.7
28.50	8	822	62.08	2.18	-85239	14	819	61.79	2.17	22500	0.30	0.1	11	746	76	5.74	72	5.44	0.30	0.3
29.00	5	827	62.46	2.15	-85771	7	826	62.31	2.15	22000	0.15	0.0	7	753	74	5.59	72	5.44	0.15	0.2
29.50	7	834	62.99	2.14	-86202	8	833	62.92	2.13	21440	0.08	0.0	9	762	72	5.44	71	5.36	0.08	0.1
30.00	5	839	63.37	2.11	-86722	4	837	63.22	2.11	20900	0.15	0.0	7	769	70	5.29	68	5.14	0.15	0.2
30.50	6	845	63.82	2.09	-87207	4	841	63.52	2.08	20400	0.30	0.1	5	774	71	5.36	67	5.06	0.30	0.3
31.00	9	854	64.50	[illegible]	-87692	5	846	63.90	2.06	20000	0.60	0.2	8	782	72	5.44	64	4.83	0.60	0.7
31.50	10	864	65.26	2.07	-88196	1	847	63.97	2.03	19590	1.28	0.4	3	785	79	5.97	62	4.68	1.28	1.4
32.00	5	869	65.63	2.05	-88771	8	855	64.57	2.02	19200	1.06	0.3	7	792	77	5.82	63	4.76	1.06	1.2
32.50	5	874	66.01	2.03	-89307	5	860	64.95	2.00	18792	1.06	0.3	5	797	77	5.82	63	4.76	1.06	1.2
33.00	3	877	66.24	2.01	-89926	12	872	65.86	2.00	18040	0.38	0.1	7	804	73	5.51	68	5.14	0.38	0.4
33.50	7	884	66.77	1.99	-90433	6	878	66.31	1.95	17777	0.45	0.1	9	813	71	5.36	65	4.91	0.45	0.5
34.00	6	890	67.22	1.98	-90941	8	886	66.92	1.97	17325	0.30	0.1	6	819	71	5.36	67	5.06	0.30	0.3
34.50	2	892	67.37	1.95	-91417	6	892	67.37	1.95	16841	0.00	0.0	4	823	69	5.21	69	5.21	0.00	0.0
35.00	5	897	67.75	1.94	-91816	11	903	68.20	1.95	16330	-0.45	-0.1	6	829	68	5.14	74	5.59	-0.45	-0.5
35.50	5	902	68.13	1.92	-92346	4	907	68.50	1.93	16100	-0.38	-0.1	3	832	70	5.29	75	5.66	-0.38	-0.4
36.00	8	910	68.73	1.91	-92970	4	911	68.81	1.91	15600	-0.08	-0.0	5	837	73	5.51	74	5.59	-0.08	-0.1
36.50	6	916	69.18	1.90	-93523	0	911	68.81	1.89	15230	0.38	0.1	3	843	76	5.74	71	5.36	0.38	0.4
37.00	9	925	69.86	1.89	-93979	8	919	69.41	1.88	15000	0.45	0.1	9	849	76	5.74	70	5.29	0.45	0.5
37.50	6	931	70.32	1.88	-94510	3	922	69.64	1.86	14567	0.68	0.2	5	854	77	5.82	68	5.14	0.69	0.7
38.00	8	939	70.92	1.87	-95073	5	927	70.02	1.84	14200	0.91	0.3	6	860	79	5.97	67	5.06	0.91	1.0
38.50	7	946	71.45	1.85	-95782	8	935	70.62	1.83	14000	0.83	0.3	6	866	78	5.89	67	5.06	0.83	0.9
39.00	0	946	71.45	1.83	-96253	11	946	71.45	1.83	13600	0.00	0.0	8	874	72	5.44	72	5.44	0.00	0.0
39.50	9	955	72.13	1.83	-97065	7	953	71.98	1.82	13200	0.15	0.0	6	880	75	5.66	73	5.51	0.15	0.2
40.00	5	960	72.51	1.81	-97462	5	958	72.36	1.81	12900	0.15	0.0	8	888	72	5.44	70	5.29	0.15	0.2
40.50	15	975	73.64	1.82	-97461	6	964	72.81	1.80	12500	0.83	0.2	10	898	77	5.82	66	4.98	0.83	0.9
41.00	6	981	74.09	1.81	-98527	19	983	74.24	1.81	12000	-0.15	-0.0	15	913	68	5.14	70	5.29	-0.15	-0.2
41.50	4	985	74.40	1.79	-98875	0	983	74.24	1.79	12000	0.15	0.0	2	915	70	5.29	68	5.14	0.15	0.2
42.00	9	994	75.08	1.79	-99290	1	984	74.32	1.77	11792	0.76	0.2	5	920	74	5.59	64	4.83	0.76	0.9
42.50	5	999	75.45	1.78	-99807	4	988	74.62	1.76	11338	0.83	0.2	4	924	75	5.66	64	4.83	0.83	0.9
43.00	6	1005	75.91	1.77	-100340	1	989	74.70	1.74	11075	1.21	0.4	6	930	75	5.66	59	4.46	1.21	1.4
43.50	3	1008	76.13	1.75	-100771	4	993	75.00	1.72	10870	1.13	0.3	4	934	74	5.59	59	4.45	1.13	1.3
44.00	4	1012	76.44	1.74	-101321	8	1001	75.60	1.72	10500	0.83	0.2	6	940	72	5.44	61	4.61	0.83	1.0
44.50	8	1020	77.04	1.73	-101800	8	1009	76.21	1.71	10200	0.83	0.2	12	952	68	5.14	57	4.31	0.83	1.0
45.00	4	1024	77.34	1.72	-102352	10	1019	76.95	1.71	10000	0.38	0.1	6	958	66	4.98	61	4.61	0.38	0.4
45.50	1	1025	77.42	1.70	-102695	1	1020	77.04	1.69	9341	0.38	0.1	0	958	67	5.06	62	4.68	0.38	0.4
46.00	7	1032	77.95	1.69	-103410	3	1023	77.27	1.68	9611	0.68	0.2	6	964	68	5.14	59	4.46	0.68	0.8
46.50	7	1039	78.47	1.69	-103881	2	1025	77.42	1.66	9324	1.06	0.3	6	970	69	5.21	55	4.15	1.06	1.3
47.00	2	1041	78.63	1.67	-104575	6	1031	77.87	1.65	9180	0.76	0.2	5	975	66	4.98	56	4.23	0.76	0.9
47.50	5	1046	79.00	1.66	-105012	13	1044	78.85	1.66	9000	0.15	0.0	8	983	63	4.76	61	4.61	0.15	0.2
48.00	2	1048	79.15	1.65	-105596	4	1048	79.15	1.65	8300	0.00	0.0	2	985	63	4.76	63	4.76	0.00	0.0
48.50	10	1058	79.91	1.65	-106071	6	1054	79.61	1.64	8500	0.30	0.1	9	994	64	4.83	60	4.53	0.30	0.4
49.00	4	1062	80.21	1.64	-106457	8	1062	80.21	1.64	8252	0.00	0.0	7	1001	61	4.61	61	4.61	0.00	0.0
49.50	4	1066	80.51	1.63	-106906	9	1071	80.89	1.63	8001	-0.38	-0.1	11	1012	54	4.08	59	4.46	-0.38	-0.5
50.00	3	1069	80.74	1.61	-107579	0	1071	80.89	1.62	8000	-0.15	-0.0	3	1015	54	4.08	56	4.23	-0.15	-0.2

TABLE C-10. COLEMAN-STEWART VERSUS NEW HAMPSHIRE AUTOMATIC GATES

% Xing	COLEMAN-STEWART INC ACC	CUM #ACC	% ACC	POWER FACTR	HAZARD INDEX	NEW HAMPSHIRE CT INC ACC	CUM #ACC	% ACC	POWER FACTR	HAZARD INDEX	WITH MATCH %DIFF	TVAL	INC MTCH	CUM MTCH	CS LESS MACC	MATCH % ACC	NH LESS MACC	MATCH % ACC	LESS MATCH %DIFF	TVAL
0.50	3	3	0.85	1.69	-57143	7	7	1.98	3.65	1272000	-1.13	-1.3	0	0	3	0.85	7	1.98	-1.13	-1.3
1.00	6	9	2.54	2.56	-56923	7	14	3.95	2.75	934420	-1.41	-1.0	3	3	6	1.69	11	3.11	-1.41	-1.2
1.50	5	14	3.95	2.66	-60710	5	19	5.37	3.53	819380	-1.41	-0.9	2	5	9	2.54	14	3.95	-1.41	-1.0
2.00	5	19	5.37	2.59	-61713	5	24	6.78	3.34	743000	-1.41	-0.8	4	9	10	2.82	15	4.24	-1.41	-1.0
2.50	2	21	5.93	2.37	-63057	3	27	7.63	3.05	577560	-1.69	-0.9	2	11	10	2.82	16	4.52	-1.69	-1.2
3.00	1	22	6.21	2.07	-63538	8	35	9.89	3.30	593400	-3.67	-1.7	1	12	10	2.82	23	6.50	-3.67	-2.3
3.50	5	27	7.63	2.19	-64625	9	44	12.43	3.55	540000	-4.80	-2.0	4	16	11	3.11	28	7.91	-4.80	-2.7
4.00	8	35	9.89	2.47	-65379	2	46	12.99	3.25	468400	-3.11	-1.2	3	19	16	4.52	27	7.63	-3.11	-1.7
4.50	3	38	10.73	2.39	-65665	3	49	13.84	3.38	458381	-3.11	-1.2	2	21	17	4.80	28	7.91	-3.11	-1.6
5.00	1	39	11.02	2.27	-65892	0	49	13.84	2.77	425000	-2.82	-1.1	0	21	18	5.08	28	7.91	-2.82	-1.5
5.50	1	40	11.30	2.05	-66232	5	54	15.25	2.77	400320	-3.95	-1.4	2	23	17	4.80	31	8.76	-3.95	-2.2
6.00	5	45	12.71	2.12	-66765	11	65	18.36	3.06	373300	-5.65	-1.9	5	28	17	4.80	37	10.45	-5.65	-2.7
6.50	8	53	14.97	2.30	-67398	7	72	20.34	3.13	350000	-5.37	-1.7	4	32	21	5.93	40	11.30	-5.37	-2.4
7.00	2	55	15.54	2.22	-67992	5	77	21.75	3.11	334400	-6.21	-1.9	4	36	19	5.37	41	11.58	-6.21	-2.8
7.50	2	57	16.10	2.15	-68291	2	79	22.32	2.98	321600	-6.21	-1.9	2	38	19	5.37	41	11.58	-6.21	-2.8
8.00	7	64	18.08	2.26	-68757	4	83	23.45	2.93	308100	-5.37	-1.6	3	41	23	6.50	42	11.86	-5.37	-2.4
8.50	3	67	18.93	2.23	-69215	6	89	25.14	2.96	297600	-6.21	-1.8	7	48	19	5.37	41	11.58	-6.21	-2.8
9.00	5	72	20.34	2.26	-69793	1	90	25.42	2.82	285200	-5.08	-1.4	5	53	19	5.37	37	10.45	-5.08	-2.4
9.50	4	76	21.47	2.25	-70394	4	94	26.55	2.80	270100	-5.08	-1.4	4	57	19	5.37	37	10.45	-5.08	-2.4
10.00	3	79	22.32	2.23	-70981	2	96	27.12	2.71	261000	-4.80	-1.3	2	59	20	5.65	37	10.45	-4.80	-2.3
10.50	6	85	24.01	2.29	-71377	0	96	27.12	2.58	254400	-3.11	-0.8	3	62	23	6.50	34	9.60	-3.11	-1.5
11.00	5	90	25.42	2.31	-71684	0	96	27.12	2.47	246400	-1.69	-0.4	0	62	28	7.91	34	9.60	-1.69	-0.8
11.50	3	93	26.27	2.28	-72049	4	100	28.25	2.46	237000	-1.98	-0.5	2	64	29	8.19	36	10.17	-1.98	-0.9
12.00	8	101	28.53	2.39	-72339	4	104	29.38	2.45	228600	-0.85	-0.2	8	72	29	8.19	32	9.04	-0.85	-0.4
12.50	1	102	28.81	2.31	-72569	7	111	31.36	2.51	220000	-2.54	-0.6	7	79	23	6.50	32	9.04	-2.54	-1.2
13.00	0	102	28.81	2.22	-72887	2	113	31.92	2.46	210000	-3.11	-0.8	2	81	21	5.93	32	9.04	-3.11	-1.5
13.50	5	107	30.23	2.24	-73416	0	113	31.92	2.36	202800	-1.69	-0.4	2	83	24	6.78	30	8.47	-1.69	-0.8
14.00	4	111	31.36	2.24	-73913	2	115	32.49	2.32	197145	-1.13	-0.3	3	86	25	7.06	29	8.19	-1.13	-0.5
14.50	0	111	31.36	2.16	-74379	2	117	33.05	2.28	190400	-1.69	-0.4	2	88	23	6.50	29	8.19	-1.69	-0.8
15.00	3	114	32.20	2.15	-75021	5	122	34.46	2.30	183720	-2.26	-0.5	3	91	23	6.50	31	8.76	-2.26	-1.1
15.50	8	122	34.46	2.22	-75630	3	125	35.31	2.28	173600	-0.85	-0.2	3	94	28	7.91	31	8.76	-0.85	-0.4
16.00	3	125	35.31	2.21	-75958	2	127	35.88	2.24	170000	-0.56	-0.1	3	97	28	7.91	30	8.47	-0.56	-0.3
16.50	3	128	36.16	2.19	-76207	2	129	36.44	2.21	168000	-0.28	-0.1	3	100	28	7.91	29	8.19	-0.28	-0.1
17.00	4	132	37.29	2.19	-76668	3	132	37.29	2.19	161500	0.00	0.0	1	101	31	8.76	31	8.76	0.00	0.0
17.50	2	134	37.85	2.16	-77111	4	136	38.42	2.20	155900	-0.56	-0.1	3	104	30	8.47	32	9.04	-0.56	-0.3
18.00	3	137	38.70	2.15	-77389	3	139	39.27	2.18	150000	-0.56	-0.1	3	107	30	8.47	32	9.04	-0.56	-0.3
18.50	6	143	40.40	2.18	-77639	2	141	39.83	2.15	147400	0.56	0.1	4	111	32	9.04	30	8.47	0.56	0.3
19.00	1	144	40.68	2.14	-77987	0	141	39.83	2.10	144000	0.85	0.2	0	111	33	9.32	30	8.47	0.85	0.4
19.50	5	149	42.09	2.15	-78414	6	147	41.53	2.13	139950	0.56	0.1	5	116	33	9.32	31	8.76	0.56	0.3
20.00	2	151	42.66	2.13	-78724	4	151	42.66	2.13	135000	0.00	0.0	3	119	32	9.04	32	9.04	0.00	0.0
20.50	2	153	43.22	2.11	-79199	1	152	42.94	2.09	131810	0.28	0.1	1	120	33	9.32	32	9.04	0.28	0.1
21.00	1	154	43.50	2.07	-79402	2	154	43.50	2.07	127500	0.00	0.0	1	121	33	9.32	33	9.32	0.00	0.0
21.50	7	161	45.48	2.12	-79720	4	158	44.63	2.08	123760	0.85	0.2	5	126	35	9.89	32	9.04	0.85	0.4
22.00	2	163	46.05	2.09	-80215	1	159	44.92	2.04	120000	1.13	0.2	2	128	35	9.89	31	8.76	1.13	0.5
22.50	0	163	46.05	2.05	-80704	1	160	45.20	2.01	118500	0.85	0.2	1	129	34	9.60	31	8.76	0.85	0.4
23.00	3	166	46.89	2.04	-81271	5	165	46.61	2.03	114504	0.28	0.1	5	134	32	9.04	31	8.76	0.28	0.1
23.50	0	166	46.89	2.00	-81515	2	167	47.18	2.01	111650	-0.28	-0.1	0	134	32	9.04	33	9.32	-0.28	-0.1
24.00	2	168	47.46	1.99	-81758	2	169	47.74	1.99	108120	-0.28	-0.1	4	138	30	8.47	31	8.76	-0.28	-0.1
24.50	3	171	48.31	1.97	-82133	3	172	48.59	1.98	105000	-0.28	-0.1	3	141	30	8.47	31	8.76	-0.28	-0.1
25.00	1	172	48.59	1.94	-82508	0	172	48.59	1.94	102400	0.00	0.0	0	141	31	8.76	31	8.76	0.00	0.0

TABLE C-10 (cont.)

% Xing	[illegible]-STEWART INC ACC	CUM #ACC	% ACC	PRICE FACTR	HAZARD INDEX	NEW HAMPSHIRE INC ACC	CUM #ACC	% ACC	PRICE FACTR	CT HAZARD INDEX	WITH MATCH %DIFF	WITH MATCH TVAL	INC MTCH	CUM MTCH	CS LESS #ACC	CS MATCH % ACC	NH LESS #ACC	NH MATCH % ACC	LESS MATCH %DIFF	LESS MATCH TVAL
25.50	3	175	49.64	1.96	-72747	3	175	49.44	1.94	100000	0.00	0.0	2	143	32	9.04	32	9.04	0.00	0.0
26.00	2	177	50.28	1.73	-63132	4	179	50.56	1.74	98066	-0.28	-0.1	3	145	32	9.04	33	9.32	-0.28	-0.1
26.50	5	182	51.69	1.86	-83366	0	179	50.56	1.81	96000	1.13	0.2	6	150	33	9.32	29	8.19	1.13	0.5
27.00	3	186	52.56	1.95	-84066	0	179	50.56	1.67	93500	1.98	0.4	1	151	35	9.89	28	7.91	1.98	0.9
27.50	1	187	53.12	1.92	-84336	6	185	52.26	1.90	90000	0.56	0.1	6	157	30	6.47	28	7.91	0.56	0.3
28.00	3	191	53.95	1.93	-84675	0	183	53.11	1.90	87695	0.85	0.2	5	162	29	8.19	26	7.34	0.85	0.4
28.50	1	192	54.24	1.90	-85087	1	183	53.30	1.57	86350	0.85	0.2	1	163	29	8.19	26	7.34	0.85	0.4
29.00	2	194	54.89	1.80	-85541	5	194	54.60	1.69	84000	0.00	0.0	4	167	27	7.63	27	7.63	0.00	0.0
29.50	2	196	55.37	1.58	-85932	0	195	54.80	1.56	82080	0.56	0.1	1	168	28	7.91	26	7.34	0.56	0.3
30.00	6	202	57.06	1.77	-86372	4	198	55.93	1.86	80000	1.13	0.2	3	171	31	8.76	27	7.63	1.13	0.5
30.50	2	204	57.63	1.84	-86532	0	198	55.93	1.63	79700	1.69	0.3	1	172	32	9.04	26	7.34	1.69	0.8
31.00	1	205	57.91	1.87	-86644	2	200	56.50	1.82	78200	1.41	0.2	2	174	31	8.76	26	7.34	1.41	0.7
31.50	1	206	58.19	1.85	-87155	0	200	56.50	1.74	75400	1.69	0.3	1	175	31	8.76	25	7.06	1.69	8.8
32.00	5	211	59.60	1.86	-87439	4	204	57.63	1.80	72100	1.98	0.3	5	180	31	8.76	24	6.78	1.98	0.9
32.50	1	212	59.89	1.84	-87564	7	211	59.60	1.83	71000	0.28	0.0	4	184	28	7.91	27	7.63	0.28	0.1
33.00	3	215	60.73	1.84	-88312	2	213	60.17	1.82	70000	0.56	0.1	0	184	31	8.76	29	8.19	0.56	0.3
33.50	0	215	60.73	1.81	-88734	2	215	60.73	1.81	68000	0.00	0.0	2	186	29	8.19	29	8.19	0.00	0.0
34.00	2	217	61.30	1.79	-89145	0	215	60.73	1.79	66000	0.56	0.1	1	187	30	8.47	28	7.91	0.56	0.3
34.50	2	219	61.86	1.79	-89483	1	216	61.02	1.77	64880	0.85	0.1	1	188	31	8.76	28	7.91	0.85	0.4
35.00	1	220	62.15	1.78	-89773	2	218	61.58	1.76	63250	0.56	0.1	1	189	31	8.76	29	8.19	0.56	0.3
35.50	2	222	62.71	1.77	-90071	3	221	62.43	1.76	62020	0.28	0.0	4	193	29	8.19	28	7.91	0.28	0.1
36.00	2	224	63.28	1.76	-90341	1	222	62.71	1.74	60600	0.56	0.1	1	194	30	8.47	28	7.91	0.56	0.3
36.50	2	226	63.84	1.75	-90791	0	222	62.71	1.72	60000	1.13	0.2	1	195	31	8.76	27	7.63	1.13	0.5
37.00	1	227	64.12	1.73	-91142	1	223	62.99	1.70	58104	1.13	0.2	2	197	30	8.47	26	7.34	1.13	0.5
37.50	5	232	65.54	1.75	-91492	6	229	64.69	1.73	56240	0.85	0.1	0	197	35	9.89	32	9.04	0.85	0.4
38.00	1	233	65.82	1.73	-91582	3	232	65.54	1.72	55000	0.28	0.0	2	199	34	9.60	33	9.32	0.28	0.1
38.50	4	237	66.95	1.74	-92007	4	236	66.67	1.73	54000	0.28	0.0	6	205	32	9.04	31	8.76	0.28	0.1
39.00	2	239	67.51	1.73	-92137	0	236	66.67	1.71	52500	0.85	0.1	2	207	32	9.04	29	8.19	0.85	0.4
39.50	1	240	67.80	1.72	-92402	0	236	66.67	1.69	51320	1.13	0.2	0	207	33	9.32	29	8.19	1.13	0.5
40.00	0	240	67.80	1.69	-92783	2	238	67.23	1.68	50040	0.56	0.1	2	209	31	8.76	29	8.19	0.56	0.3
40.50	2	242	68.36	1.69	-93046	1	239	67.51	1.67	49000	0.85	0.1	2	211	31	8.76	28	7.91	0.85	0.4
41.00	1	243	68.64	1.67	-93275	1	240	67.80	1.65	48000	0.85	0.1	1	212	31	8.76	28	7.91	0.85	0.4
41.50	2	245	69.21	1.67	-93539	1	241	68.08	1.64	47100	1.13	0.2	1	213	32	9.04	28	7.91	1.13	0.5
42.00	0	245	69.21	1.65	-93834	0	241	68.08	1.62	46000	1.13	0.2	0	213	32	9.04	28	7.91	1.13	0.5
42.50	0	245	69.21	1.63	-94143	3	244	68.93	1.62	45000	0.28	0.0	3	216	29	8.19	28	7.91	0.28	0.1
43.00	2	247	69.77	1.62	-94518	0	244	68.93	1.60	44000	0.85	0.1	2	218	29	8.19	26	7.34	0.85	0.4
43.50	1	248	70.06	1.61	-94752	1	245	69.21	1.59	42650	0.85	0.1	1	219	29	8.19	26	7.34	0.85	0.4
44.00	1	249	70.34	1.60	-94983	2	247	69.77	1.59	41280	0.56	0.1	3	222	27	7.63	25	7.06	0.56	0.3
44.50	1	250	70.62	1.59	-95261	2	249	70.34	1.58	40000	0.28	0.0	1	223	27	7.63	26	7.34	0.28	0.1
45.00	1	251	70.90	1.58	-95474	0	249	70.34	1.56	40000	0.56	0.1	1	224	27	7.63	25	7.06	0.56	0.3
45.50	5	256	72.32	1.59	-95516	2	251	70.90	1.56	39060	1.41	0.2	6	230	26	7.34	21	5.93	1.41	0.7
46.00	3	259	73.16	1.59	-95922	4	255	72.03	1.57	37800	1.13	0.2	5	235	24	6.78	20	5.65	1.13	0.6
46.50	9	268	75.71	1.63	-96230	1	256	72.32	1.56	37200	3.39	0.5	9	244	24	6.78	12	3.39	3.39	2.0
47.00	1	269	75.99	1.62	-96420	4	260	73.45	1.56	36160	2.54	0.4	3	247	22	6.21	13	3.67	2.54	1.5
47.50	0	269	75.99	1.60	-96620	1	261	73.73	1.55	36000	2.26	0.3	1	248	21	5.93	13	3.67	2.26	1.4
48.00	1	270	76.27	1.59	-96687	1	262	74.01	1.54	34450	2.26	0.3	2	250	20	5.65	12	3.39	2.26	1.4
48.50	2	272	76.84	1.58	-97107	2	264	74.58	1.54	33600	2.26	0.3	3	253	19	5.37	11	3.11	2.26	1.5
49.00	4	276	77.97	1.59	-97514	0	264	74.58	1.52	32500	3.39	0.5	1	254	22	6.21	10	2.82	3.39	2.1
49.50	0	276	77.97	1.58	-97713	0	264	74.58	1.51	32000	3.39	0.5	0	254	22	6.21	10	2.82	3.39	2.1
50.00	2	278	78.53	1.57	-97492	1	265	74.86	1.50	30800	3.67	0.6	0	254	24	6.78	11	3.11	3.67	2.2

TABLE C-11. PEABODY-DIMMICK VERSUS NEW HAMPSHIRE CROSSBUCKS

	PEABODY-DIMMICK					NEW HAMPSHIRE				CT					PD		NH			
% Xing	INC ACC	CUM #ACC	% ACC	POWER FACTR	HAZARD INDEX	INC ACC	CUM #ACC	% ACC	POWER FACTR	HAZARD INDEX	WITH MATCH %DIFF	TVAL	INC MTCH	CUM MTCH	LESS MATCH #ACC	% ACC	LESS MATCH #ACC	% ACC	LESS MATCH %DIFF	TVAL
0.50	77	77	3.88	7.76	63891	83	83	4.18	8.37	72000	-0.30	-0.5	74	74	3	0.15	9	0.45	-0.30	-1.7
1.00	60	137	6.91	6.91	59231	52	135	6.80	6.80	47300	0.10	0.1	54	128	9	0.45	7	0.35	0.10	0.5
1.50	49	186	9.38	6.25	56761	54	189	9.53	6.35	34500	-0.15	-0.2	50	178	8	0.40	11	0.55	-0.15	-0.7
2.00	51	237	11.95	5.97	54502	56	245	12.35	6.17	27200	-0.40	-0.4	53	231	6	0.30	14	0.71	-0.40	-1.8
2.50	50	287	14.47	5.79	52799	56	301	15.17	6.07	22800	-0.71	-0.6	48	279	8	0.40	22	1.11	-0.71	-2.6
3.00	38	325	16.38	5.46	51576	40	341	17.19	5.73	19200	-0.81	-0.6	42	321	4	0.20	20	1.01	-0.81	-3.3
3.50	41	366	18.45	5.27	50290	34	375	18.90	5.40	16800	-0.45	-0.3	39	360	6	0.30	15	0.76	-0.45	-2.0
4.00	32	398	20.06	5.02	49278	41	416	20.97	5.24	14800	-0.91	-0.6	30	390	8	0.40	26	1.31	-0.91	-3.1
4.50	45	443	22.33	4.96	48283	45	461	23.24	5.16	13000	-0.91	-0.6	48	438	5	0.25	23	1.16	-0.91	-3.4
5.00	40	483	24.34	4.87	47467	33	494	24.90	4.98	12000	-0.55	-0.4	36	474	9	0.45	20	1.01	-0.55	-2.0
5.50	36	519	26.16	4.76	46836	31	525	26.46	4.81	11000	-0.30	-0.2	30	504	15	0.76	21	1.06	-0.30	-1.0
6.00	16	535	26.97	4.49	46262	42	567	28.58	4.76	10000	-1.61	-1.0	27	531	4	0.20	36	1.81	-1.61	-5.1
6.50	30	565	28.48	4.38	45597	24	591	29.79	4.58	9150	-1.31	-0.8	28	559	6	0.30	32	1.61	-1.31	-4.2
7.00	30	595	29.99	4.28	44936	24	615	31.00	4.43	8500	-1.01	-0.6	27	586	9	0.45	29	1.46	-1.01	-3.2
7.50	38	633	31.91	4.25	44296	23	638	32.16	4.29	8000	-0.25	-0.1	29	615	18	0.91	23	1.16	-0.25	-0.8
8.00	33	666	33.57	4.20	43716	27	665	33.52	4.19	7484	0.05	0.0	31	646	20	1.01	19	0.96	0.05	0.2
8.50	22	688	34.68	4.08	43238	23	688	34.68	4.08	6900	0.00	0.0	27	673	15	0.76	15	0.76	0.00	0.0
9.00	21	709	35.74	3.97	42726	22	710	35.79	3.98	6400	-0.05	-0.0	22	695	14	0.71	15	0.76	-0.05	-0.2
9.50	21	730	36.79	3.87	42283	26	736	37.10	3.90	6000	-0.30	-0.2	20	715	15	0.76	21	1.06	-0.30	-1.0
10.00	26	756	38.10	3.81	41812	23	759	38.26	3.83	5600	-0.15	-0.1	27	742	14	0.71	17	0.86	-0.15	-0.5
10.50	19	775	39.06	3.72	41425	31	790	39.82	3.79	5250	-0.76	-0.4	20	762	13	0.66	28	1.41	-0.76	-2.3
11.00	23	798	40.22	3.66	41006	27	817	41.18	3.74	5000	-0.96	-0.5	24	786	12	0.60	31	1.56	-0.96	-2.9
11.50	35	833	41.99	3.65	40611	22	839	42.29	3.68	4800	-0.30	-0.1	32	818	15	0.76	21	1.06	-0.30	-1.0
12.00	17	850	42.84	3.57	40259	30	869	43.80	3.65	4400	-0.96	-0.5	18	836	14	0.71	33	1.66	-0.96	-2.8
12.50	35	885	44.61	3.57	39894	22	891	44.91	3.59	4200	-0.30	-0.1	27	863	22	1.11	28	1.41	-0.30	-0.8
13.00	11	896	45.16	3.47	39515	36	927	46.72	3.59	4000	-1.56	-0.7	26	889	7	0.35	38	1.92	-1.56	-4.6
13.50	31	927	46.72	3.46	39205	13	940	47.38	3.51	3800	-0.66	-0.3	28	917	10	0.50	23	1.16	-0.66	-2.3
14.00	18	945	47.63	3.40	38857	17	957	48.24	3.45	3600	-0.60	-0.3	18	935	10	0.50	22	1.11	-0.60	-2.1
14.50	24	969	48.84	3.37	38493	8	965	48.64	3.35	3500	0.20	0.1	15	950	19	0.96	15	0.76	0.20	0.7
15.00	9	978	49.29	3.29	38251	23	988	49.80	3.32	3240	-0.50	-0.2	20	970	8	0.40	18	0.91	-0.50	-2.0
15.50	16	994	50.10	3.23	37990	15	1003	50.55	3.26	3070	-0.45	-0.2	13	983	11	0.55	20	1.01	-0.45	-1.6
16.00	20	1014	51.11	3.19	37657	31	1034	52.12	3.26	3000	-1.01	-0.4	23	1006	8	0.40	28	1.41	-1.01	-3.3
16.50	24	1038	52.32	3.17	37319	1	1035	52.17	3.16	2948	0.15	0.1	12	1018	20	1.01	17	0.86	0.15	0.5
17.00	15	1053	53.07	3.12	37093	19	1054	53.13	3.13	2800	-0.05	-0.0	21	1039	14	0.71	15	0.76	-0.05	-0.2
17.50	14	1067	53.78	3.07	36848	21	1075	54.18	3.10	2600	-0.40	-0.2	17	1056	11	0.55	19	0.96	-0.40	-1.5
18.00	19	1086	54.74	3.04	36561	15	1090	54.94	3.05	2500	-0.20	-0.1	18	1074	12	0.60	16	0.81	-0.20	-0.8
18.50	15	1101	55.49	3.00	36282	23	1113	56.10	3.03	2400	-0.60	-0.3	17	1091	10	0.50	22	1.11	-0.60	-2.1
19.00	13	1114	56.15	2.96	36097	0	1113	56.10	2.95	2400	0.05	0.0	10	1101	13	0.66	12	0.60	0.05	0.2
19.50	15	1129	56.91	2.92	35929	17	1130	56.96	2.92	2240	-0.05	-0.0	12	1113	16	0.81	17	0.86	-0.05	-0.2
20.00	4	1133	57.11	2.86	35676	12	1142	57.56	2.88	2130	-0.45	-0.2	10	1123	10	0.50	19	0.96	-0.45	-1.7
20.50	12	1145	57.71	2.82	35459	45	1187	59.83	2.92	2000	-2.12	-0.9	20	1143	2	0.10	44	2.22	-2.12	-6.2
21.00	11	1156	58.27	2.77	35229	0	1187	59.83	2.85	2000	-1.56	-0.6	9	1152	4	0.20	35	1.76	-1.56	-5.0
21.50	13	1169	58.92	2.74	34995	0	1187	59.83	2.78	2000	-0.91	-0.4	9	1161	8	0.40	26	1.31	-0.91	-3.1
22.00	14	1183	59.63	2.71	34830	8	1195	60.23	2.74	1900	-0.60	-0.2	13	1174	9	0.45	21	1.06	-0.60	-2.2
22.50	23	1206	60.79	2.70	34563	22	1217	61.34	2.73	1800	-0.55	-0.2	21	1195	11	0.55	22	1.11	-0.55	-1.9
23.00	8	1214	61.19	2.66	34299	11	1228	61.90	2.69	1750	-0.71	-0.3	9	1204	10	0.50	24	1.21	-0.71	-2.4
23.50	10	1224	61.69	2.63	34184	14	1242	62.60	2.66	1620	-0.91	-0.4	13	1217	7	0.35	25	1.26	-0.91	-3.2
24.00	22	1246	62.80	2.62	33906	18	1260	63.51	2.65	1600	-0.71	-0.3	22	1239	7	0.35	21	1.06	-0.71	-2.6
24.50	15	1261	63.56	2.59	33693	10	1270	64.01	2.61	1520	-0.45	-0.2	14	1253	8	0.40	17	0.86	-0.45	-1.8
25.00	18	1279	64.47	2.58	33508	25	1295	65.27	2.61	1500	-0.81	-0.3	22	1275	4	0.20	20	1.01	-0.81	-3.3

TABLE C-11. (cont.)

% Xing	PEABODY-DIMMICK INC ACC	CUM #ACC	% ACC	POWER FACTR	HAZARD INDEX	NEW HAMPSHIRE INC ACC	CUM #ACC	% ACC	POWER FACTR	CT HAZARD INDEX	WITH MATCH %DIFF	TVAL	INC MTCH	CUM MTCH	PD LESS #ACC	MATCH % ACC	NH LESS #ACC	MATCH % ACC	LESS MATCH %DIFF	TVAL
25.50	9	1288	64.92	2.55	33373	1	1296	65.32	2.56	1460	-0.40	-0.2	1	1276	12	0.60	20	1.01	-0.40	-1.4
26.00	15	1303	65.68	2.53	33095	15	1311	66.08	2.54	1400	-0.40	-0.2	17	1293	10	0.50	18	0.91	-0.40	-1.5
26.50	12	1315	66.28	2.50	32887	6	1317	66.38	2.50	1350	-0.10	-0.0	11	1304	11	0.55	13	0.66	-0.10	-0.4
27.00	8	1323	66.68	2.47	32628	9	1326	66.83	2.48	1280	-0.15	-0.1	5	1309	14	0.71	17	0.86	-0.15	-0.5
27.50	13	1336	67.34	2.45	32510	8	1334	67.24	2.45	1220	0.10	0.0	7	1316	20	1.01	18	0.91	0.10	0.3
28.00	16	1352	68.15	2.43	32359	30	1364	68.75	2.46	1200	-0.60	-0.2	21	1337	15	0.76	27	1.36	-0.60	-1.9
28.50	12	1364	68.75	2.41	32135	0	1364	68.75	2.41	1200	0.00	0.0	7	1344	20	1.01	20	1.01	0.00	0.0
29.00	19	1383	69.71	2.40	31935	13	1377	69.41	2.39	1120	0.30	0.1	14	1358	25	1.26	19	0.96	0.30	0.9
29.50	15	1398	70.46	2.39	31838	13	1390	70.06	2.37	1080	0.40	0.2	20	1378	20	1.01	12	0.60	0.40	1.4
30.00	4	1402	70.67	2.36	31544	11	1401	70.61	2.35	1020	0.05	0.0	7	1385	17	0.86	16	0.81	0.05	0.2
30.50	13	1415	71.32	2.34	31518	37	1438	72.48	2.38	1000	-1.16	-0.4	25	1410	5	0.25	28	1.41	-1.16	-4.0
31.00	9	1424	71.77	2.32	31384	0	1438	72.48	2.34	1000	-0.71	-0.3	6	1416	8	0.40	22	1.11	-0.71	-2.6
31.50	15	1439	72.53	2.30	31154	0	1438	72.48	2.30	1000	0.05	0.0	4	1420	19	0.96	18	0.91	0.05	0.2
32.00	13	1452	73.19	2.29	30974	19	1457	73.44	2.29	925	-0.25	-0.1	18	1438	14	0.71	19	0.96	-0.25	-0.9
32.50	10	1462	73.69	2.27	30747	19	1476	74.40	2.29	900	-0.71	-0.3	13	1451	11	0.55	25	1.26	-0.71	-2.3
33.00	7	1469	74.04	2.24	30653	1	1477	74.45	2.26	890	-0.40	-0.1	8	1459	10	0.50	18	0.91	-0.40	-1.5
33.50	18	1487	74.95	2.24	30433	1[illegible]	1489	75.05	2.24	840	-0.10	-0.0	21	1480	7	0.35	9	0.45	-0.10	-0.5
34.00	12	1499	75.55	2.22	30344	27	1516	76.41	2.25	800	-0.86	-0.3	16	1496	3	0.15	20	1.01	-0.86	-3.5
34.50	7	1506	75.91	2.20	30178	0	1516	76.41	2.21	800	-0.50	-0.2	3	1499	7	0.35	17	0.86	-0.50	-2.0
35.00	5	1511	76.16	2.18	30057	3	1519	76.56	2.19	776	-0.40	-0.1	2	1501	10	0.50	18	0.91	-0.40	-1.5
35.50	14	1525	76.86	2.17	29906	9	1528	77.02	2.17	750	-0.15	-0.1	17	1518	7	0.35	10	0.50	-0.15	-0.7
36.00	9	1534	77.32	2.15	29680	17	1545	77.87	2.16	720	-0.55	-0.2	7	1525	9	0.45	20	1.01	-0.55	-2.0
36.50	13	1547	77.97	2.14	29495	7	1552	78.23	2.14	700	-0.25	-0.1	10	1535	12	0.60	17	0.86	-0.25	-0.9
37.00	16	1563	78.78	2.13	29279	5	1557	78.48	2.12	660	0.30	0.1	9	1544	19	0.96	13	0.66	0.30	1.1
37.50	2	1565	78.88	2.10	29215	7	1564	78.83	2.10	640	0.05	0.0	8	1552	13	0.66	12	0.60	0.05	0.2
38.00	10	1575	79.39	2.09	29001	37	1601	80.70	2.12	600	-1.31	-0.5	22	1574	1	0.05	27	1.36	-1.31	-4.9
38.50	11	1586	79.94	2.08	28896	0	1601	80.70	2.10	600	-0.76	-0.3	6	1580	6	0.30	21	1.06	-0.76	-2.9
39.00	6	1592	80.24	2.06	28691	0	1601	80.70	2.07	600	-0.45	-0.2	4	1584	8	0.40	17	0.86	-0.45	-1.8
39.50	8	1600	80.65	2.04	28575	0	1601	80.70	2.04	594	-0.05	-0.0	6	1590	10	0.50	11	0.55	-0.05	-0.2
40.00	17	1617	81.50	2.04	28386	11	1612	81.25	2.03	550	0.25	0.1	11	1601	16	0.81	11	0.55	0.25	1.0
40.50	0	1617	81.50	2.01	28386	6	1618	81.55	2.01	522	-0.05	-0.0	1	1602	15	0.76	16	0.81	-0.05	-0.2
41.00	0	1617	81.50	1.99	28386	23	1641	82.71	2.02	500	-1.21	-0.4	15	1617	0	0.00	24	1.21	-1.21	-4.9
41.50	7	1624	81.85	1.97	28189	0	1641	82.71	1.99	500	-0.86	-0.3	6	1623	1	0.05	18	0.91	-0.86	-3.9
42.00	10	1634	82.36	1.96	27986	0	1641	82.71	1.97	500	-0.35	-0.1	7	1630	4	0.20	11	0.55	-0.35	-1.8
42.50	10	1644	82.86	1.95	27817	0	1641	82.71	1.95	500	0.15	0.1	2	1632	12	0.60	9	0.45	0.15	0.7
43.00	8	1652	83.27	1.94	27607	7	1648	83.06	1.93	480	0.20	0.1	8	1640	12	0.60	8	0.40	0.20	0.9
43.50	2	1654	83.37	1.92	27459	4	1652	83.27	1.91	460	0.10	0.0	6	1646	8	0.40	6	0.30	0.10	0.5
44.00	9	1663	83.82	1.91	27329	9	1661	83.72	1.90	450	0.10	0.0	7	1653	10	0.50	8	0.40	0.10	0.5
44.50	0	1663	83.82	1.88	27329	7	1668	84.07	1.89	420	-0.25	-0.1	3	1656	7	0.35	12	0.60	-0.25	-1.1
45.00	5	1668	84.07	1.87	27096	23	1691	85.23	1.89	400	-1.16	-0.4	12	1668	0	0.00	23	1.16	-1.16	-4.8
45.50	14	1682	84.78	1.86	26971	0	1691	85.23	1.87	400	-0.45	-0.2	13	1681	1	0.05	10	0.50	-0.45	-2.7
46.00	0	1682	84.78	1.84	26971	0	1691	85.23	1.85	400	-0.45	-0.2	0	1681	1	0.05	10	0.50	-0.45	-2.7
46.50	8	1690	85.18	1.83	26716	0	1691	85.23	1.83	400	-0.05	-0.0	6	1687	3	0.15	4	0.20	-0.05	-0.4
47.00	3	1693	85.33	1.82	26618	1	1692	85.28	1.81	376	0.05	0.0	3	1690	3	0.15	2	0.10	0.05	0.4
47.50	5	1698	85.58	1.80	26392	7	1699	85.64	1.80	360	-0.05	-0.0	5	1695	3	0.15	4	0.20	-0.05	-0.4
48.00	0	1698	85.58	1.78	26287	0	1699	85.64	1.78	350	-0.05	-0.0	0	1695	3	0.15	4	0.20	-0.05	-0.4
48.50	2	1700	85.69	1.77	26087	5	1704	85.89	1.77	326	-0.20	-0.1	4	1699	1	0.05	5	0.25	-0.20	-1.6
49.00	4	1704	85.89	1.75	26025	5	1709	86.14	1.76	320	-0.25	-0.1	1	1700	4	0.20	9	0.45	-0.25	-1.4
49.50	3	1707	86.04	1.74	25875	14	1723	86.84	1.75	300	-0.81	-0.3	7	1707	0	0.00	16	0.81	-0.81	-4.0
50.00	8	1715	86.44	1.73	25684	0	1723	86.84	1.74	300	-0.40	-0.1	5	1712	3	0.15	11	0.55	-0.40	-2.1

TABLE C-12. PEABODY-DIMMICK VERSUS NEW HAMPSHIRE FLASHING LIGHTS

% Xing	PEABODY-DIMMICK INC ACC	CUM #ACC	% ACC	POWER FACTR	HAZARD INDEX	NEW HAMPSHIRE INC ACC	CUM #ACC	% ACC	POWER FACTR	CT HAZARD INDEX	WITH MATCH %DIFF	TVAL	INC MTCH	CUM MTCH	PD LESS MATCH #ACC	% ACC	NH LESS MATCH #ACC	% ACC	LESS MATCH %DIFF	TVAL
0.50	54	54	4.08	8.16	86919	55	55	4.15	8.31	487800	-0.08	-0.1	53	53	1	0.08	2	0.15	-0.08	-0.6
1.00	31	85	6.42	6.42	81747	34	89	6.72	6.72	337790	-0.30	-0.3	30	83	2	0.15	6	0.45	-0.30	-1.4
1.50	39	124	9.37	6.24	78485	26	115	8.69	5.79	268380	0.68	C.6	30	113	11	0.83	2	0.15	0.68	2.5
2.00	23	147	11.10	5.55	76919	29	144	10.88	5.44	234000	0.23	0.2	25	138	9	0.68	6	0.45	0.23	0.8
2.50	26	173	13.07	5.23	75609	25	169	12.76	5.11	210000	0.30	0.2	26	164	9	0.68	5	0.38	0.30	1.1
3.00	22	195	14.73	4.91	74343	29	198	14.95	4.98	183820	-0.23	-0.2	27	191	4	0.30	7	0.53	-0.23	-0.9
3.50	26	221	16.69	4.77	73010	19	217	16.39	4.68	169400	0.30	0.2	24	215	6	0.45	2	0.15	0.30	1.4
4.00	13	234	17.67	4.42	72058	14	231	17.45	4.36	153088	0.23	0.1	12	227	7	0.53	4	0.30	0.23	0.9
4.50	21	255	19.26	4.28	71009	19	250	18.88	4.20	139000	0.38	0.2	19	246	9	0.68	4	0.30	0.38	1.4
5.00	20	275	20.77	4.15	70194	23	273	20.62	4.12	128000	0.15	C.1	20	266	9	0.68	7	0.53	0.15	0.5
5.50	22	297	22.43	4.08	69424	23	296	22.36	4.06	120800	0.08	0.0	20	286	11	0.83	10	0.76	0.08	0.2
6.00	26	323	24.40	4.07	68787	26	322	24.32	4.05	112720	0.08	C.0	29	315	8	0.60	7	0.53	0.08	0.3
6.50	18	341	25.76	3.96	67983	18	340	25.68	3.95	106981	0.08	0.0	15	330	11	0.83	10	0.76	0.08	0.2
7.00	18	359	27.11	3.87	67418	24	364	27.49	3.93	100000	-0.38	-0.2	22	352	7	0.53	12	0.91	-0.38	-1.1
7.50	17	376	28.40	3.79	66764	15	379	28.63	3.82	94560	-0.23	-0.1	15	367	9	0.68	12	0.91	-0.23	-0.7
8.00	11	387	29.23	3.65	66251	18	397	29.98	3.75	90000	-0.76	-C.4	16	383	4	0.30	14	1.06	-0.76	-2.4
8.50	20	407	30.74	3.62	65644	10	407	30.74	3.62	85400	0.00	0.0	16	399	8	0.60	8	0.60	0.00	0.0
9.00	14	421	31.80	3.53	65208	15	422	31.87	3.54	81700	-0.08	-0.0	15	414	7	0.53	8	0.60	-0.08	-0.3
9.50	11	432	32.63	3.43	64853	6	428	32.33	3.40	78880	0.30	0.1	6	420	12	0.91	8	0.60	0.30	0.9
10.00	18	450	33.99	3.40	64355	12	440	33.23	3.32	75600	0.76	0.3	14	434	16	1.21	6	0.45	0.76	2.1
10.50	10	460	34.74	3.31	63803	14	454	34.29	3.27	72000	0.45	C.2	12	446	14	1.06	8	0.60	0.45	1.3
11.00	8	468	35.35	3.21	63470	18	472	35.65	3.24	69225	-0.30	-0.1	14	460	8	0.60	12	0.91	-0.30	-0.9
11.50	16	484	36.56	3.18	63026	20	492	37.16	3.23	66000	-0.60	-0.3	20	480	4	0.30	12	0.91	-0.60	-2.0
12.00	15	499	37.69	3.14	62709	12	504	38.07	3.17	64000	-0.38	-0.2	12	492	7	0.53	12	0.91	-0.38	-1.1
12.50	9	508	38.37	3.07	62254	11	515	38.90	3.11	61088	-0.53	-C.2	8	500	8	0.60	15	1.13	-0.53	-1.5
13.00	7	515	38.90	2.99	61912	8	523	39.50	3.04	59800	-0.60	-0.2	10	510	5	0.38	13	0.98	-0.60	-1.9
13.50	14	529	39.95	2.96	61372	8	531	40.11	2.97	56480	-0.15	-C.1	10	520	9	0.68	11	0.83	-0.15	-0.4
14.00	13	542	40.94	2.92	61012	16	547	41.31	2.95	54000	-0.38	-0.2	12	532	10	0.76	15	1.13	-0.38	-1.0
14.50	20	562	42.45	2.93	60554	15	562	42.45	2.93	51500	0.00	C.0	19	551	11	0.83	11	0.83	0.00	0.0
15.00	12	574	43.35	2.89	60231	9	571	43.13	2.88	49940	0.23	0.1	14	565	9	0.68	6	0.45	0.23	0.8
15.50	12	586	44.26	2.86	59859	12	583	44.03	2.84	48000	0.23	0.1	9	574	12	0.91	9	0.68	0.23	0.7
16.00	8	594	44.86	2.80	59533	5	588	44.41	2.78	46554	0.45	C.2	4	578	16	1.21	10	0.76	0.45	1.2
16.50	11	605	45.69	2.77	59192	22	610	46.07	2.79	45000	-0.38	-0.1	18	596	9	0.68	14	1.06	-0.38	-1.0
17.00	6	611	46.15	2.71	58883	6	616	46.53	2.74	43260	-0.38	-C.1	7	603	8	0.60	13	0.98	-0.38	-1.1
17.50	12	623	47.05	2.69	58558	7	623	47.05	2.69	41990	0.00	0.0	8	611	12	0.91	12	0.91	0.00	0.0
18.00	9	632	47.73	2.65	58278	17	640	48.34	2.69	40390	-0.60	-C.2	12	623	9	0.68	17	1.28	-0.60	-1.6
18.50	7	639	48.26	2.61	58060	8	648	48.94	2.65	40000	-0.68	-0.3	8	631	8	0.60	17	1.28	-0.68	-1.8
19.00	17	656	49.55	2.61	57716	8	656	49.55	2.61	38800	0.00	0.0	9	640	16	1.21	16	1.21	0.00	0.0
19.50	14	670	50.60	2.60	57400	13	669	50.53	2.59	37500	0.08	0.0	11	651	19	1.44	18	1.36	0.08	0.2
20.00	8	678	51.21	2.56	57073	17	686	51.81	2.59	36000	-0.60	-0.2	14	665	13	0.98	21	1.59	-0.60	-1.4
20.50	8	686	51.81	2.53	56811	6	692	52.27	2.55	35000	-0.45	-C.2	9	674	12	0.91	18	1.36	-0.45	-1.1
21.00	5	691	52.19	2.49	56609	8	700	52.87	2.52	34000	-0.68	-0.2	5	679	12	0.91	21	1.59	-0.68	-1.6
21.50	11	702	53.02	2.47	56326	9	709	53.55	2.49	33000	-0.53	-C.2	17	696	6	0.45	13	0.98	-0.53	-1.6
22.00	6	708	53.47	2.43	56058	6	715	54.00	2.45	32000	-0.53	-C.2	6	702	6	0.45	13	0.98	-0.53	-1.6
22.50	8	716	54.08	2.40	55772	7	722	54.53	2.42	30940	-0.45	-C.2	8	710	6	0.45	12	0.91	-0.45	-1.4
23.00	15	731	55.21	2.40	55569	9	731	55.21	2.40	30000	0.00	0.0	12	722	9	0.68	9	0.68	0.00	0.0
23.50	8	739	55.82	2.38	55317	4	735	55.51	2.36	29700	0.30	0.1	5	727	12	0.91	8	0.60	0.30	0.9
24.00	6	745	56.27	2.34	55062	9	744	56.19	2.34	28800	0.08	0.0	8	735	10	0.76	9	0.68	0.08	0.2
24.50	6	751	56.72	2.32	54770	9	753	56.87	2.32	28000	-0.15	-0.1	5	740	11	0.83	13	0.98	-0.15	-0.4
25.00	5	756	57.10	2.28	54505	9	762	57.55	2.30	27000	-0.45	-C.2	6	746	10	0.76	16	1.21	-0.45	-1.2

TABLE C-12. (cont.)

% Xing	PEABODY-DIMMICK INC ACC	CUM #ACC	% ACC	POWER FACTR	HAZARD INDEX	NEW HAMPSHIRE INC ACC	CUM #ACC	% ACC	POWER FACTR	CT HAZARD INDEX	WITH MATCH %DIFF	TVAL	INC MTCH	CUM MTCH	PD LESS #ACC	MATCH % ACC	NH LESS #ACC	MATCH % ACC	LESS MATCH %DIFF	TVAL
25.50	4	760	57.40	2.25	54262	7	769	58.08	2.28	26270	-0.68	-0.2	6	752	8	0.60	17	1.28	-0.68	-1.8
26.00	8	768	58.01	2.23	54065	13	782	59.06	2.27	25600	-1.06	-0.4	11	763	5	0.38	19	1.44	-1.06	-2.9
26.50	10	778	58.76	2.22	53803	7	789	59.59	2.25	25000	-0.83	-0.3	7	770	8	0.60	19	1.44	-0.83	-2.1
27.00	10	788	59.52	2.20	53595	6	795	60.05	2.22	24290	-0.53	-0.2	12	782	6	0.45	13	0.98	-0.53	-1.6
27.50	6	794	59.97	2.18	53368	5	800	60.42	2.20	24000	-0.45	-0.2	4	786	8	0.60	14	1.06	-0.45	-1.3
28.00	8	802	60.57	2.16	53154	5	805	60.80	2.17	23200	-0.23	-0.1	5	791	11	0.83	14	1.06	-0.23	-0.6
28.50	3	805	60.80	2.13	53003	13	818	61.78	2.17	22500	-0.98	-0.3	9	800	5	0.38	18	1.36	-0.98	-2.7
29.00	8	813	61.40	2.12	52799	7	825	62.31	2.15	22000	-0.91	-0.3	9	809	4	0.30	16	1.21	-0.91	-2.7
29.50	5	818	61.78	2.09	52625	8	833	62.92	2.13	21440	-1.13	-0.4	5	814	4	0.30	19	1.44	-1.13	-3.1
30.00	7	825	62.31	2.08	52448	4	837	63.22	2.11	20900	-0.91	-0.3	6	820	5	0.38	17	1.28	-0.91	-2.6
30.50	4	829	62.61	2.05	52221	4	841	63.52	2.08	20400	-0.91	-0.3	5	825	4	0.30	16	1.21	-0.91	-2.7
31.00	7	836	63.14	2.04	51957	5	846	63.90	2.06	20000	-0.76	-0.2	6	831	5	0.38	15	1.13	-0.76	-2.2
31.50	4	840	63.44	2.01	51716	1	847	63.97	2.03	19680	-0.53	-0.2	1	832	8	0.60	15	1.13	-0.53	-1.5
32.00	5	845	63.82	1.99	51517	8	855	64.58	2.02	19200	-0.76	-0.2	4	836	9	0.68	19	1.44	-0.76	-1.9
32.50	9	854	64.50	1.98	51278	5	860	64.95	2.00	18792	-0.45	-0.1	9	845	9	0.68	15	1.13	-0.45	-1.2
33.00	7	861	65.03	1.97	51105	12	872	65.86	2.00	18040	-0.83	-0.3	6	851	10	0.76	21	1.59	-0.83	-2.0
33.50	11	872	65.86	1.97	50869	6	878	66.31	1.98	18000	-0.45	-0.1	14	865	7	0.53	13	0.98	-0.45	-1.3
34.00	8	880	66.47	1.95	50648	8	886	66.92	1.97	17325	-0.45	-0.1	7	872	8	0.60	14	1.06	-0.45	-1.3
34.50	5	885	66.84	1.94	50476	6	892	67.37	1.95	16848	-0.53	-0.2	4	876	9	0.68	16	1.21	-0.53	-1.4
35.00	8	893	67.45	1.93	50250	11	903	68.20	1.95	16380	-0.76	-0.2	12	888	5	0.38	15	1.13	-0.76	-2.2
35.50	6	899	67.90	1.91	50017	4	907	68.50	1.93	16000	-0.60	-0.2	6	894	5	0.38	13	0.98	-0.60	-1.9
36.00	5	904	68.28	1.90	49793	4	911	68.81	1.91	15600	-0.53	-0.2	2	896	8	0.60	15	1.13	-0.53	-1.5
36.50	4	908	68.58	1.88	49600	0	911	68.81	1.89	15230	-0.23	-0.1	4	900	8	0.60	11	0.83	-0.23	-0.7
37.00	6	914	69.03	1.87	49391	8	919	69.41	1.88	15000	-0.38	-0.1	7	907	7	0.53	12	0.91	-0.38	-1.1
37.50	10	924	69.79	1.86	49183	3	922	69.64	1.86	14560	0.15	0.0	4	911	13	0.98	11	0.83	0.15	0.4
38.00	7	931	70.32	1.85	49003	5	927	70.02	1.84	14220	0.30	0.1	5	916	15	1.13	11	0.83	0.30	0.8
38.50	5	936	70.69	1.84	48752	8	935	70.62	1.83	14000	0.08	0.0	7	923	13	0.98	12	0.91	0.08	0.2
39.00	2	938	70.85	1.82	48540	11	946	71.45	1.83	13600	-0.60	-0.2	8	931	7	0.53	15	1.13	-0.60	-1.7
39.50	7	945	71.37	1.81	48332	7	953	71.98	1.82	13200	-0.60	-0.2	6	937	8	0.60	16	1.21	-0.60	-1.6
40.00	11	956	72.21	1.81	48114	5	958	72.36	1.81	12800	-0.15	-0.0	10	947	9	0.68	11	0.83	-0.15	-0.4
40.50	4	960	72.51	1.79	48008	6	964	72.81	1.80	12500	-0.30	-0.1	5	952	8	0.60	12	0.91	-0.30	-0.9
41.00	7	967	73.04	1.78	47788	19	983	74.24	1.81	12000	-1.21	-0.4	11	963	4	0.30	20	1.51	-1.21	-3.3
41.50	12	979	73.94	1.78	47585	0	983	74.24	1.79	12000	-0.30	-0.1	8	971	8	0.60	12	0.91	-0.30	-0.9
42.00	8	987	74.55	1.77	47360	1	984	74.32	1.77	11792	0.23	0.1	5	976	11	0.83	8	0.60	0.23	0.7
42.50	6	993	75.00	1.76	47236	4	988	74.62	1.76	11388	0.38	0.1	6	982	11	0.83	6	0.45	0.38	1.2
43.00	4	997	75.30	1.75	47082	1	989	74.70	1.74	11025	0.60	0.2	3	985	12	0.91	4	0.30	0.60	2.0
43.50	1	998	75.38	1.73	46903	4	993	75.00	1.72	10800	0.38	0.1	2	987	11	0.83	6	0.45	0.38	1.2
44.00	6	1004	75.83	1.72	46685	8	1001	75.60	1.72	10500	0.23	0.1	5	992	12	0.91	9	0.68	0.23	0.7
44.50	6	1010	76.28	1.71	46476	8	1009	76.21	1.71	10200	0.08	0.0	6	998	12	0.91	11	0.83	0.08	0.2
45.00	0	1010	76.28	1.70	46290	10	1019	76.96	1.71	10000	-0.68	-0.2	5	1003	7	0.53	16	1.21	-0.68	-1.9
45.50	7	1017	76.81	1.69	46041	1	1020	77.04	1.69	9840	-0.23	-0.1	3	1006	11	0.83	14	1.06	-0.23	-0.6
46.00	7	1024	77.34	1.68	45868	3	1023	77.27	1.68	9600	0.08	0.0	5	1011	13	0.98	12	0.91	0.08	0.2
46.50	4	1028	77.64	1.67	45690	2	1025	77.42	1.66	9324	0.23	0.1	4	1015	13	0.98	10	0.76	0.23	0.6
47.00	3	1031	77.87	1.66	45506	6	1031	77.87	1.66	9180	0.00	0.0	5	1020	11	0.83	11	0.83	0.00	0.0
47.50	3	1034	78.10	1.64	45390	13	1044	78.85	1.66	9000	-0.76	-0.2	5	1025	9	0.68	19	1.44	-0.76	-1.9
48.00	4	1038	78.40	1.63	45169	4	1048	79.15	1.65	8800	-0.76	-0.2	7	1032	6	0.45	16	1.21	-0.76	-2.1
48.50	5	1043	78.78	1.62	44947	6	1054	79.61	1.64	8500	-0.83	-0.2	5	1037	6	0.45	17	1.28	-0.83	-2.3
49.00	5	1048	79.15	1.62	44845	8	1062	80.21	1.64	8250	-1.06	-0.3	4	1041	7	0.53	21	1.59	-1.06	-2.6
49.50	3	1051	79.38	1.60	44659	9	1071	80.89	1.63	8000	-1.51	-0.4	6	1047	4	0.30	24	1.81	-1.51	-3.8
50.00	6	1057	79.83	1.60	44457	0	1071	80.89	1.62	8000	-1.06	-0.3	5	1052	5	0.38	19	1.44	-1.06	-2.9

TABLE C-13. PEABODY-DIMMICK VERSUS NEW HAMPSHIRE AUTOMATIC GATES

% Xing	PEABODY-DIMMICK INC ACC	CUM #ACC	% ACC	POWER FACTR	HAZARD INDEX	NEW HAMPSHIRE INC ACC	CUM #ACC	% ACC	POWER FACTR	HAZARD INDEX	CT WITH MATCH %DIFF	TVAL	INC MTCH	CUM MTCH	PD LESS MATCH #ACC	% ACC	NH LESS MATCH #ACC	% ACC	LESS MATCH %DIFF	TVAL
0.50	5	5	1.41	2.82	100920	7	7	1.98	3.95	1272000	-0.56	-0.6	5	5	0	0.00	2	0.56	-0.56	-1.4
1.00	8	13	3.67	3.67	95995	7	14	3.95	3.95	939420	-0.28	-0.2	8	13	0	0.00	1	0.28	-0.28	-1.0
1.50	3	16	4.52	3.01	94219	5	19	5.37	3.58	819360	-0.85	-0.5	3	16	0	0.00	3	0.85	-0.85	-1.7
2.00	7	23	6.50	3.25	92468	5	24	6.78	3.39	748000	-0.28	-0.1	6	22	1	0.28	2	0.56	-0.28	-0.6
2.50	4	27	7.63	3.05	90886	3	27	7.63	3.05	677660	0.00	0.0	4	26	1	0.28	1	0.28	0.00	0.0
3.00	5	32	9.04	3.01	89333	8	35	9.89	3.30	593400	-0.85	-0.4	3	29	3	0.85	6	1.69	-0.85	-1.0
3.50	8	40	11.30	3.23	88022	9	44	12.43	3.55	540000	-1.13	-0.4	10	39	1	0.28	5	1.41	-1.13	-1.6
4.00	5	45	12.71	3.18	86509	2	46	12.99	3.25	488400	-0.28	-0.1	5	44	1	0.28	2	0.56	-0.28	-0.6
4.50	6	51	14.41	3.20	85506	3	49	13.84	3.08	458080	0.56	0.2	5	49	2	0.56	0	0.00	0.56	1.4
5.00	2	53	14.97	2.99	84612	0	49	13.84	2.77	425000	1.13	0.4	0	49	4	1.13	0	0.00	1.13	2.0
5.50	2	55	15.54	2.82	83701	5	54	15.25	2.77	400320	0.28	0.1	4	53	2	0.56	1	0.28	0.28	0.6
6.00	5	60	16.95	2.82	82848	11	65	18.36	3.06	373800	-1.41	-0.4	7	60	0	0.00	5	1.41	-1.41	-2.2
6.50	6	66	18.64	2.87	62063	7	72	20.34	3.13	350000	-1.69	-0.5	6	66	0	0.00	6	1.69	-1.69	-2.4
7.00	5	71	20.06	2.87	81517	5	77	21.75	3.11	334400	-1.69	-0.5	4	70	1	0.28	7	1.98	-1.69	-2.1
7.50	6	77	21.75	2.90	80981	2	79	22.32	2.98	321600	-0.56	-0.2	6	76	1	0.28	3	0.85	-0.56	-1.0
8.00	5	82	23.16	2.90	80544	4	83	23.45	2.93	308100	-0.28	-0.1	3	79	3	0.85	4	1.13	-0.28	-0.4
8.50	8	90	25.42	2.99	79908	6	89	25.14	2.96	297600	0.28	0.1	8	87	3	0.85	2	0.56	0.28	0.4
9.00	1	91	25.71	2.86	79445	1	90	25.42	2.82	285200	0.28	0.1	2	89	2	0.56	1	0.28	0.28	0.6
9.50	1	92	25.99	2.74	78941	4	94	26.55	2.80	270100	-0.56	-0.1	3	92	0	0.00	2	0.56	-0.56	-1.4
10.00	1	93	26.27	2.63	78667	2	96	27.12	2.71	261000	-0.85	-0.2	1	93	0	0.00	3	0.85	-0.85	-1.7
10.50	1	94	26.55	2.53	78119	0	96	27.12	2.58	254400	-0.56	-0.1	1	94	0	0.00	2	0.56	-0.56	-1.4
11.00	1	95	26.84	2.44	77664	0	96	27.12	2.47	246400	-0.28	-0.1	0	94	1	0.28	2	0.56	-0.28	-0.6
11.50	1	96	27.12	2.36	77124	4	100	28.25	2.46	237000	-1.13	-0.3	2	96	0	0.00	4	1.13	-1.13	-2.0
12.00	9	105	29.66	2.47	76438	4	104	29.38	2.45	228600	0.28	0.1	7	103	2	0.56	1	0.28	0.28	0.6
12.50	4	109	30.79	2.46	76066	7	111	31.36	2.51	220000	-0.56	-0.1	4	107	2	0.56	4	1.13	-0.56	-0.8
13.00	4	113	31.92	2.46	75642	2	113	31.92	2.46	210000	0.00	0.0	5	112	1	0.28	1	0.28	0.00	0.0
13.50	3	116	32.77	2.43	75103	0	113	31.92	2.36	202800	0.85	0.2	1	113	3	0.85	0	0.00	0.85	1.7
14.00	3	119	33.62	2.40	74681	2	115	32.49	2.32	197145	1.13	0.3	2	115	4	1.13	0	0.00	1.13	2.0
14.50	2	121	34.18	2.36	74053	2	117	33.05	2.28	190400	1.13	0.3	2	117	4	1.13	0	0.00	1.13	2.0
15.00	1	122	34.46	2.30	73727	5	122	34.46	2.30	183720	0.00	0.0	4	121	1	0.28	1	0.28	0.00	0.0
15.50	1	123	34.75	2.24	73400	3	125	35.31	2.28	173600	-0.56	-0.1	0	121	2	0.56	4	1.13	-0.56	-0.8
16.00	2	125	35.31	2.21	72914	2	127	35.88	2.24	170000	-0.56	-0.1	1	122	3	0.85	5	1.41	-0.56	-0.7
16.50	5	130	36.72	2.23	72576	2	129	36.44	2.21	168000	0.28	0.1	4	126	4	1.13	3	0.85	0.28	0.4
17.00	0	130	36.72	2.16	72450	3	132	37.29	2.19	161500	-0.56	-0.1	1	127	3	0.85	5	1.41	-0.56	-0.7
17.50	3	133	37.57	2.15	71841	4	136	38.42	2.20	155800	-0.85	-0.2	5	132	1	0.28	4	1.13	-0.85	-1.3
18.00	0	133	37.57	2.09	71550	3	139	39.27	2.18	150000	-1.69	-0.4	1	133	0	0.00	6	1.69	-1.69	-2.4
18.50	4	137	38.70	2.09	71253	2	141	39.83	2.15	147400	-1.13	-0.2	4	137	0	0.00	4	1.13	-1.13	-2.0
19.00	1	138	38.98	2.05	70902	0	141	39.83	2.10	144000	-0.85	-0.2	1	138	0	0.00	3	0.85	-0.85	-1.7
19.50	6	144	40.68	2.09	70569	6	147	41.53	2.13	139950	-0.85	-0.2	6	144	0	0.00	3	0.85	-0.85	-1.7
20.00	2	146	41.24	2.06	70358	4	151	42.66	2.13	135000	-1.41	-0.3	2	146	0	0.00	5	1.41	-1.41	-2.2
20.50	2	148	41.81	2.04	69977	1	152	42.94	2.09	131810	-1.13	-0.2	1	147	1	0.28	5	1.41	-1.13	-1.6
21.00	3	151	42.66	2.03	69681	2	154	43.50	2.07	127500	-0.85	-0.2	3	150	1	0.28	4	1.13	-0.85	-1.3
21.50	2	153	43.22	2.01	69277	4	158	44.63	2.08	123760	-1.41	-0.3	3	153	0	0.00	5	1.41	-1.41	-2.2
22.00	1	154	43.50	1.98	69038	1	159	44.92	2.04	120000	-1.41	-0.3	1	154	0	0.00	5	1.41	-1.41	-2.2
22.50	3	157	44.35	1.97	68746	1	160	45.20	2.01	118500	-0.85	-0.2	1	155	2	0.56	5	1.41	-0.85	-1.1
23.00	4	161	45.48	1.98	68432	5	165	46.61	2.03	114504	-1.13	-0.2	4	159	2	0.56	6	1.69	-1.13	-1.4
23.50	6	167	47.18	2.01	68063	2	167	47.18	2.01	111650	0.00	0.0	4	163	4	1.13	4	1.13	0.00	0.0
24.00	5	172	48.59	2.02	67730	2	169	47.74	1.99	108120	0.85	0.2	3	166	6	1.69	3	0.85	0.85	1.0
24.50	0	172	48.59	1.98	67386	3	172	48.59	1.98	105000	0.00	0.0	3	169	3	0.85	3	0.85	0.00	0.0
25.00	1	173	48.87	1.95	67137	0	172	48.59	1.94	102400	0.28	0.1	0	169	4	1.13	3	0.85	0.28	0.4

TABLE C-13. (cont.)

% Xing	PEABODY-DINNICK INC ACC	CUM #ACC	% ACC	POWER FACTR	HAZARD INDEX	NEW HAMPSHIRE INC ACC	CUM #ACC	% ACC	POWER FACTR	HAZARD INDEX	CT WITH MATCH %DIFF	TVAL	INC MTCH	CUM MTCH	PO LESS MATCH #ACC	% ACC	NH LESS MATCH #ACC	% ACC	LESS MATCH %DIFF	TVAL
25.50	2	175	49.44	1.94	66959	3	175	49.44	1.94	100000	0.00	0.0	4	173	2	0.56	2	0.56	0.00	0.0
26.00	2	177	50.00	1.92	66697	4	179	50.56	1.94	98064	-0.56	-0.1	4	177	0	0.00	2	0.56	-0.56	-1.4
26.50	2	179	50.56	1.91	66429	0	179	50.56	1.91	96000	0.00	0.0	1	178	1	0.28	1	0.28	0.00	0.0
27.00	1	180	50.85	1.88	66178	0	179	50.56	1.87	93500	0.28	0.1	1	179	1	0.28	0	0.00	0.28	1.0
27.50	3	183	51.69	1.88	65731	6	185	52.26	1.90	90000	-0.56	-0.1	2	181	2	0.56	4	1.13	-0.56	-0.3
28.00	1	184	51.98	1.86	65476	3	188	53.11	1.90	87696	-1.13	-0.2	2	183	1	0.28	5	1.41	-1.13	-1.6
28.50	1	185	52.26	1.83	65241	1	189	53.39	1.87	86350	-1.13	-0.2	1	184	1	0.28	5	1.41	-1.13	-1.6
29.00	4	189	53.39	1.84	65099	5	194	54.80	1.89	84000	-1.41	-0.3	4	188	1	0.28	6	1.69	-1.41	-1.9
29.50	2	191	53.95	1.83	64804	0	194	54.80	1.86	82080	-0.85	-0.2	1	189	2	0.56	5	1.41	-0.85	-1.1
30.00	2	193	54.52	1.82	64565	4	198	55.93	1.86	80000	-1.41	-0.3	3	192	1	0.28	6	1.69	-1.41	-1.9
30.50	2	195	55.08	1.81	64388	0	198	55.93	1.83	79200	-0.85	-0.2	2	194	1	0.28	4	1.13	-0.85	-1.3
31.00	3	198	55.93	1.80	64149	2	200	56.50	1.82	78200	-0.56	-0.1	4	198	0	0.00	2	0.56	-0.56	-1.4
31.50	2	200	56.50	1.79	63827	0	200	56.50	1.79	75400	0.00	0.0	0	198	2	0.56	2	0.56	0.00	0.0
32.00	1	201	56.78	1.77	63602	4	204	57.63	1.80	72100	-0.85	-0.1	3	201	0	0.00	3	0.85	-0.85	-1.7
32.50	3	204	57.63	1.77	63370	7	211	59.60	1.83	71000	-1.98	-0.3	2	203	1	0.28	8	2.26	-1.98	-2.3
33.00	4	208	58.76	1.78	63153	2	213	60.17	1.82	70000	-1.41	-0.2	2	205	3	0.85	8	2.26	-1.41	-1.5
33.50	5	213	60.17	1.80	62959	2	215	60.73	1.81	68000	-0.56	-0.1	6	211	2	0.56	4	1.13	-0.56	-0.8
34.00	0	213	60.17	1.77	62660	0	215	60.73	1.79	66000	-0.56	-0.1	0	211	2	0.56	4	1.13	-0.56	-0.8
34.50	1	214	60.45	1.75	62349	1	216	61.02	1.77	64880	-0.56	-0.1	1	212	2	0.56	4	1.13	-0.56	-0.8
35.00	2	216	61.02	1.74	62199	2	218	61.58	1.76	63250	-0.56	-0.1	3	215	1	0.28	3	0.85	-0.56	-1.0
35.50	2	218	61.58	1.73	61948	3	221	62.43	1.76	62020	-0.85	-0.1	1	216	2	0.56	5	1.41	-0.85	-1.1
36.00	3	221	62.43	1.73	61663	1	222	62.71	1.74	60600	-0.28	-0.0	2	218	3	0.85	4	1.13	-0.28	-0.4
36.50	2	223	62.99	1.73	61440	0	222	62.71	1.72	60000	0.28	0.0	2	220	3	0.85	2	0.56	0.28	0.4
37.00	0	223	62.99	1.70	61197	1	223	62.99	1.70	58104	0.00	0.0	1	221	2	0.56	2	0.56	0.00	0.0
37.50	4	227	64.12	1.71	60998	6	229	64.69	1.73	56240	-0.56	-0.1	1	222	5	1.41	7	1.98	-0.56	-0.6
38.00	1	228	64.41	1.69	60652	3	232	65.54	1.72	55000	-1.13	-0.2	3	225	3	0.85	7	1.98	-1.13	-1.3
38.50	0	228	64.41	1.67	60388	4	236	66.67	1.73	54000	-2.26	-0.4	2	227	1	0.28	9	2.54	-2.26	-2.5
39.00	1	229	64.69	1.66	60231	0	236	66.67	1.71	52500	-1.98	-0.3	1	228	1	0.28	8	2.26	-1.98	-2.3
39.50	2	231	65.25	1.65	59970	0	236	66.67	1.69	51320	-1.41	-0.2	2	230	1	0.28	6	1.69	-1.41	-1.9
40.00	0	231	65.25	1.63	59828	2	238	67.23	1.68	50040	-1.98	-0.3	1	231	0	0.00	7	1.98	-1.98	-2.6
40.50	1	232	65.54	1.62	59601	1	239	67.51	1.67	49000	-1.98	-0.3	0	231	1	0.28	8	2.26	-1.98	-2.3
41.00	0	232	65.54	1.60	59465	1	240	67.80	1.65	48000	-2.26	-0.4	0	231	1	0.28	9	2.54	-2.26	-2.5
41.50	7	239	67.51	1.63	59243	1	241	68.08	1.64	47100	-0.56	-0.1	7	238	1	0.28	3	0.85	-0.56	-1.0
42.00	2	241	68.08	1.62	59008	0	241	68.08	1.62	46000	0.00	0.0	2	240	1	0.28	1	0.28	0.00	0.0
42.50	0	241	68.08	1.60	58828	3	244	68.93	1.62	45000	-0.85	-0.1	1	241	0	0.00	3	0.85	-0.85	-1.7
43.00	2	243	68.64	1.60	58528	0	244	68.93	1.60	44000	-0.28	-0.0	2	243	0	0.00	1	0.28	-0.28	-1.0
43.50	2	245	69.21	1.59	58165	1	245	69.21	1.59	42650	0.00	0.0	0	243	2	0.56	2	0.56	0.00	0.0
44.00	2	247	69.77	1.59	57940	2	247	69.77	1.59	41280	0.00	0.0	2	245	2	0.56	2	0.56	0.00	0.0
44.50	2	249	70.34	1.58	57619	2	249	70.34	1.58	40000	0.00	0.0	3	248	1	0.28	1	0.28	0.00	0.0
45.00	0	249	70.34	1.56	57389	0	249	70.34	1.56	40000	0.00	0.0	0	248	1	0.28	1	0.28	0.00	0.0
45.50	0	249	70.34	1.55	57197	2	251	70.90	1.56	39060	-0.56	-0.1	1	249	0	0.00	2	0.56	-0.56	-1.4
46.00	1	250	70.62	1.54	56970	4	255	72.03	1.57	37800	-1.41	-0.2	1	250	0	0.00	5	1.41	-1.41	-2.2
46.50	1	251	70.90	1.52	56763	1	256	72.32	1.56	37200	-1.41	-0.2	0	250	1	0.28	6	1.69	-1.41	-1.9
.00	3	254	71.75	1.53	56403	4	260	73.45	1.56	36160	-1.69	-0.3	2	252	2	0.56	8	2.26	-1.69	-1.9
47.50	2	256	72.32	1.52	56214	1	261	73.73	1.55	36000	-1.41	-0.2	2	254	2	0.56	7	1.98	-1.41	-1.7
48.00	1	257	72.60	1.51	55961	1	262	74.01	1.54	34450	-1.41	-0.2	1	255	2	0.56	7	1.98	-1.41	-1.7
48.50	2	259	73.16	1.51	55760	2	264	74.58	1.54	33600	-1.41	-0.2	2	257	2	0.56	7	1.98	-1.41	-1.7
49.00	3	262	74.01	1.51	55629	0	264	74.58	1.52	32500	-0.56	-0.1	3	260	2	0.56	4	1.13	-0.56	-0.8
49.50	0	262	74.01	1.50	55422	0	264	74.58	1.51	32000	-0.56	-0.1	0	260	2	0.56	4	1.13	-0.56	-0.8
50.00	4	266	75.14	1.50	55280	1	265	74.86	1.50	30800	0.28	0.0	5	265	1	0.28	0	0.00	0.28	1.0

APPENDIX D

REGRESSIONS

The following symbols are used as shorthand identifiers in the regressions.

1. AADT - average daily traffic.
2. ACC - a crossing from the accident data base.
3. C - same as 1.
4. DT, DTHRU, DAY THRU - number of day thru trains.
5 DAY SWITCH - number of day switch trains.
6. FC, FC-ROAD - the units digit of the functional classification of road over crossing.
7. FLGV19.DAT - the file name of the regression which is the volume model for flashing lights.
8. GATE09 - the file name of the regression which is the volume model for gates.
9. H, H(ofVIT16) - the file name of the regression which is the volume model for crossbucks.
10. HWY PAVED - is highway paved?
11. LANES - the number of traffic lanes.
12. LOG, LOGIO - refers to LOG_{10}.
13. LOG T**2 - refers to $[LOG_{10}(T+1)]^2$.
14. LOG C**2 - refers to $[LOG_{10}(C+1)]^2$.
15. MAIN TRACKS, MAIN TRKS - the number of main tracks.
16. MAX, MAX SPEED - typical maximum speed.
17. MIN - typical minimum speed.
18. N, NITE - the number of night trains.
19. NITE SWITCH - the number of night switch trains.
20. NITE THRU - the number of night thru trains.
21. NOACC - a crossing from the non-accident data base.
22. NRBY XING HWY - nearby intersecting highway?
23. OPEN=1 NOT OPEN=2 - from type of development: open is open space (1) and not open is otherwise (2, 3, 4, 5).

24. POP, POPULATION - the tens digit of the functional classification of road over crossing.
25. RESID=2 NON-RESID=1 - from type of development: resid is residential (2), non-resid is otherwise (1, 3, 4, 5).
26. RR ADV WARN - is railroad advance warning sign present?
27. SWITCH - number of switch trains.
28. T, TRAIN - number of total train movements.
29. TRUCKS - estimated percent trucks.
30. TYP MAX SPEED - same as 16.
31. TYP MIN SPEED - typical minimum speed.
32. U=1 R=2, U=0 R=1 - from highway system U is urban and R is rural.
33. XING ANGLES - smallest crossing angle.
34. 1 - refers to the intercept of a non-linear regression.
35. 10K - 10,000.
36. * - multiplication sign.
37. ** - exponent sign.

LIST OF TABLES IN APPENDIX D

TABLE D-1. TYPICAL LINEAR REGRESSION EARLY EXPLORATORY STAGE

STEP-WISE MULTIPLE REGRESSION.....BIGREG

NUMBER OF OBSERVATIONS [illegible]
NUMBER OF VARIABLES 2[illegible]
NUMBER OF SELECTIONS 1

CONSTANT TO LIMIT VARIABLES 0.[illegible]

VARIABLE NO.	MEAN	STANDARD DEVIATION	VARIABLE
1	[illegible]	[illegible]	LANES
2	[illegible]	[illegible]	AADT
3	[illegible]	[illegible].78962	FC - ROAD
4	[illegible]	[illegible]	POPULATION
5	1.[illegible]527	[illegible]	U=1 R=2
6	[illegible]	[illegible]	XING ANGLE
7	1.[illegible]627	[illegible]	OPEN=1 NOT OPEN=2
8	1.23[illegible]	[illegible]	RESID=2 NON-RESID=1
9	1.[illegible]166	[illegible]7752	VARY XINGWAY Y=1 N=2
10	[illegible]	[illegible]	HWY PAVED Y=1 N=2
11	[illegible]	[illegible]	MAIN TRACKS
12	[illegible]	17.71[illegible]4	TYP MAX SPEED
13	14.1732[illegible]	14.[illegible]37	TYP MIN SPEED
14	2.[illegible]	3.[illegible]	DAY THRU
15	[illegible]	2.47134	DAY SWITCH
16	2.1[illegible]	3.74[illegible]	NITE THRU
17	[illegible]	2.[illegible]	NITE SWITCH
18	[illegible].47[illegible]	[illegible]	LOG10(TRAIN +.3)
19	2.[illegible]	[illegible].75391	LOG10(AADT+.3)
20	35.72[illegible]	11[illegible]	FC * AADT
21	314.[illegible]	1[illegible]	AADT/(LANES+.3)
22	24.1[illegible]	4[illegible]3437	AADT*DTHRU **.5112
23	[illegible]	295[illegible]	AADT/(POP+.3)
24	[illegible]	61.[illegible]5177	#22 * (4-XING ANG)
25	3.7[illegible]	1[illegible]	MAX*DTHRU*AADT/1[illegible]
26	4.[illegible]377	2[illegible].12527	MIN*TRAIN*AADT/1[illegible]
27	1724.[illegible]	7361.[illegible]431	AADT*DTHRU/(POP+.3)
28	[illegible]	[illegible].26134	ACC=1 NOACC=0

SELECTION..... 1

DEPENDENT VARIABLE.............28
NUMBER OF VARIABLES FORCED..... [illegible]
NUMBER OF VARIABLES DELETED... 0

TABLE D-1 (cont.)

STEP 1

VARIABLE ENTERED.....22

SUM OF SQUARES REDUCED IN THIS STEP.... 76.6[illegible]
PROPORTION REDUCED IN THIS STEP........ 0.066

CUMULATIVE SUM OF SQUARES REDUCED...... 76.6[illegible]
CUMULATIVE PROPORTION REDUCED.......... 0.066 OF 1154.135

FOR 1 VARIABLES ENTERED
MULTIPLE CORRELATION COEFFICIENT... 0.258
(ADJUSTED FOR D.F.)........... 0.258
F-VALUE FOR ANALYSIS OF VARIANCE... 12[illegible]2.7[illegible]7
STANDARD ERROR OF ESTIMATE......... 0.253
(ADJUSTED FOR D.F.)........... 0.253

VARIABLE NUMBER	REGRESSION COEFFICIENT	STD. ERROR OF REG. COEFF.	COMPUTED T-VALUE
22	[illegible].[illegible]0153	0.[illegible]0[illegible]	34.[illegible]1
INTERCEPT	[illegible].[illegible]3524		

STEP 2

VARIABLE ENTERED.....1[illegible]

SUM OF SQUARES REDUCED IN THIS STEP.... 10.510
PROPORTION REDUCED IN THIS STEP........ 0.0[illegible]9

CUMULATIVE SUM OF SQUARES REDUCED...... 87.22[illegible]
CUMULATIVE PROPORTION REDUCED.......... 0.076 OF 1154.135

FOR 2 VARIABLES ENTERED
MULTIPLE CORRELATION COEFFICIENT... 0.275
(ADJUSTED FOR D.F.)........... 0.275
F-VALUE FOR ANALYSIS OF VARIANCE... 6[illegible]0.422
STANDARD ERROR OF ESTIMATE......... 0.251
(ADJUSTED FOR D.F.)........... 0.251

VARIABLE NUMBER	REGRESSION COEFFICIENT	STD. ERROR OF REG. COEFF.	COMPUTED T-VALUE
22	0.[illegible]0145	0.[illegible]0005	31.[illegible]47
1[illegible]	-0.05196	0.00403	-12.[illegible]2
INTERCEPT	0.1120[illegible]		

TABLE D-1 (cont.)

STEP 3

VARIABLE ENTERED.....18

SUM OF SQUARES REDUCED IN THIS STEP.... 6.632
PROPORTION REDUCED IN THIS STEP........ 0.006

CUMULATIVE SUM OF SQUARES REDUCED...... 93.832
CUMULATIVE PROPORTION REDUCED.......... 0.081 OF 1154.135

FOR 3 VARIABLES ENTERED
MULTIPLE CORRELATION COEFFICIENT... 0.285
(ADJUSTED FOR D.F.)............ 0.285
F-VALUE FOR ANALYSIS OF VARIANCE... 498.231
STANDARD ERROR OF ESTIMATE.......... 0.281
(ADJUSTED FOR D.F.)............ 0.281

VARIABLE NUMBER	REGRESSION COEFFICIENT	STD. ERROR OF REG. COEFF.	COMPUTED T-VALUE
22	0.00121	0.00005	22.723
14	-0.05614	0.00404	-13.916
18	0.03893	0.00380	10.256
INTERCEPT	0.10557		

STEP 4

VARIABLE ENTERED.....19

SUM OF SQUARES REDUCED IN THIS STEP.... 4.739
PROPORTION REDUCED IN THIS STEP........ 0.004

CUMULATIVE SUM OF SQUARES REDUCED...... 98.540
CUMULATIVE PROPORTION REDUCED.......... 0.085 OF 1154.135

FOR 4 VARIABLES ENTERED
MULTIPLE CORRELATION COEFFICIENT... 0.292
(ADJUSTED FOR D.F.)............ 0.292
F-VALUE FOR ANALYSIS OF VARIANCE... 394.228
STANDARD ERROR OF ESTIMATE.......... 0.250
(ADJUSTED FOR D.F.)............ 0.250

VARIABLE NUMBER	REGRESSION COEFFICIENT	STD. ERROR OF REG. COEFF.	COMPUTED T-VALUE
22	0.00107	0.00006	17.252
14	-0.03302	0.00483	-6.838
18	0.04687	0.00390	12.032
19	0.03005	0.00345	8.732
INTERCEPT	0.20797		

STEP 5

VARIABLE ENTERED..... 4

SUM OF SQUARES REDUCED IN THIS STEP.... 2.12[illegible]
PROPORTION REDUCED IN THIS STEP........ 0.0[illegible]2

CUMULATIVE SUM OF SQUARES REDUCED...... 170.651
CUMULATIVE PROPORTION REDUCED.......... 0.[illegible]17 OF 1154.13[illegible]

FOR 5 VARIABLES ENTERED
MULTIPLE CORRELATION COEFFICIENT... 0.295
(ADJUSTED FOR D.F.)............ 0.295
F-VALUE FOR ANALYSIS OF VARIANCE... 322.849
STANDARD ERROR OF ESTIMATE......... 0.25[illegible]
(ADJUSTED FOR D.F.)............ 0.250

VARIABLE NUMBER	REGRESSION COEFFICIENT	STD. ERROR OF REG. COEFF.	COMPUTED T-VALUE
22	[illegible].[illegible]212[illegible]	[illegible].[illegible]0[illegible]06	17.[illegible]7
1[illegible]	-[illegible].[illegible]3[illegible]8[illegible]	0.[illegible]0484	-[illegible].[illegible]71
1[illegible]	[illegible].[illegible]4557	0.[illegible]039[illegible]	11.[illegible]
1[illegible]	[illegible].[illegible]222[illegible]	[illegible].[illegible]037[illegible]	6.[illegible]1[illegible]
4	[illegible].[illegible]2[illegible]74	0.[illegible]015[illegible]	5.[illegible]31
INTERCEPT	-[illegible].[illegible]1515		

STEP 6

VARIABLE ENTERED..... 3

SUM OF SQUARES REDUCED IN THIS STEP.... 1.379
PROPORTION REDUCED IN THIS STEP........ 0.[illegible]

CUMULATIVE SUM OF SQUARES REDUCED...... 1[illegible]2.0[illegible]
CUMULATIVE PROPORTION REDUCED.......... 0.[illegible] OF 1154.1[illegible]

FOR 6 VARIABLES ENTERED
MULTIPLE CORRELATION COEFFICIENT... 0.297
(ADJUSTED FOR D.F.)............ 0.297
F-VALUE FOR ANALYSIS OF VARIANCE... 273.[illegible]
STANDARD ERROR OF ESTIMATE......... 0.25[illegible]
(ADJUSTED FOR D.F.)............ 0.2[illegible]

VARIABLE NUMBER	REGRESSION COEFFICIENT	STD. ERROR OF REG. COEFF.	COMPUTED T-VALUE
22	[illegible].[illegible]212[illegible]	[illegible].[illegible]0[illegible]06	17.3[illegible]
1[illegible]	-[illegible].[illegible]3[illegible]5[illegible]	0.[illegible]0483	-6.[illegible]
1[illegible]	[illegible].[illegible]4747	0.[illegible]0392	12.121
1[illegible]	[illegible].[illegible]1542	[illegible].[illegible]0394	3.[illegible]
4	[illegible].[illegible]2944	0.[illegible]015[illegible]	6.273
3	-[illegible].[illegible]1329	0.00278	-4.7[illegible]5
INTERCEPT	[illegible].[illegible]22[illegible]		

TABLE D-1 (cont.)

STEP 7

VARIABLE ENTERED.....11

SUM OF SQUARES REDUCED IN THIS STEP.... 1.3[illegible]9
PROPORTION REDUCED IN THIS STEP........ 0.[illegible]1

CUMULATIVE SUM OF SQUARES REDUCED...... 1[illegible]3.439
CUMULATIVE PROPORTION REDUCED.......... 0.[illegible] OF 1154.135

FOR 7 VARIABLES ENTERED
MULTIPLE CORRELATION COEFFICIENT... 0.299
(ADJUSTED FOR D.F.)............ 0.2[illegible]
F-VALUE FOR ANALYSIS OF VARIANCE... 237.57[illegible]
STANDARD ERROR OF ESTIMATE......... 0.249
(ADJUSTED FOR D.F.)............ 0.249

VARIABLE NUMBER	REGRESSION COEFFICIENT	STD. ERROR OF REG. COEFF.	COMPUTED T-VALUE
22	[illegible].[illegible]97	0.[illegible]06	15.[illegible]
1[illegible]	-[illegible].[illegible]3[illegible]4[illegible]	0.[illegible]483	-6.[illegible]
1[illegible]	[illegible].[illegible]434[illegible]	0.[illegible]401	1[illegible].[illegible]
1[illegible]	[illegible].[illegible]1[illegible]44	0.[illegible]401	4.[illegible]
4	[illegible].[illegible]1[illegible]94	0.[illegible]0154	7.11[illegible]
3	-[illegible].[illegible]134[illegible]	0.[illegible]0278	-4.[illegible]27
11	[illegible].[illegible]2591	0.[illegible]546	4.743
INTERCEPT	[illegible].[illegible]7526		

STEP 8

VARIABLE ENTERED..... [illegible]

SUM OF SQUARES REDUCED IN THIS STEP.... 0.845
PROPORTION REDUCED IN THIS STEP........ 0.[illegible]1

CUMULATIVE SUM OF SQUARES REDUCED...... 1[illegible]4.3[illegible]5
CUMULATIVE PROPORTION REDUCED.......... 0.[illegible] OF 1154.135

FOR 8 VARIABLES ENTERED
MULTIPLE CORRELATION COEFFICIENT... 0.3[illegible]1
(ADJUSTED FOR D.F.)............ 0.3[illegible]
F-VALUE FOR ANALYSIS OF VARIANCE... 2[illegible]9.773
STANDARD ERROR OF ESTIMATE......... 0.249
(ADJUSTED FOR D.F.)............ 0.249

VARIABLE NUMBER	REGRESSION COEFFICIENT	STD. ERROR OF REG. COEFF.	COMPUTED T-VALUE
22	[illegible].[illegible]93	0.[illegible]0[illegible]6	1[illegible].7[illegible]
1[illegible]	-[illegible].[illegible]291[illegible]	0.[illegible]484	-6.[illegible]2[illegible]
1[illegible]	[illegible].[illegible]4254	0.[illegible]0401	1[illegible].[illegible]3
1[illegible]	[illegible].[illegible]1[illegible]	0.[illegible]0401	4.[illegible]
4	[illegible].[illegible]1[illegible]7[illegible]	0.[illegible]0154	7.[illegible]
3	-[illegible].[illegible]1363	0.[illegible]027[illegible]	-4.[illegible]1
11	[illegible].[illegible]261[illegible]	0.[illegible]0546	4.7[illegible]
9	-[illegible].[illegible]1253	0.[illegible]0336	-3.731
INTERCEPT	[illegible].[illegible]9575		

TABLE D-1 (cont.)

STEP 9

VARIABLE ENTERED.....17

SUM OF SQUARES REDUCED IN THIS STEP.... 0.720
PROPORTION REDUCED IN THIS STEP........ 0.001

CUMULATIVE SUM OF SQUARES REDUCED...... 105.475
CUMULATIVE PROPORTION REDUCED.......... 0.091 OF 1154.135

FOR 9 VARIABLES ENTERED
MULTIPLE CORRELATION COEFFICIENT... 0.302
(ADJUSTED FOR D.F.)........... 0.301
F-VALUE FOR ANALYSIS OF VARIANCE... 108.878
STANDARD ERROR OF ESTIMATE......... 0.249
(ADJUSTED FOR D.F.)........... 0.249

VARIABLE NUMBER	REGRESSION COEFFICIENT	STD. ERROR OF REG. COEFF.	COMPUTED T-VALUE
22	[illegible]	0.00086	15.[illegible]
1[illegible]	-0.02937	0.00464	-6.[illegible]
1[illegible]	0.03[illegible]	0.00414	[illegible]
1[illegible]	0.01715	0.00402	4.272
4	0.01[illegible]	0.00155	6.[illegible]
[illegible]	-0.01[illegible]	0.00278	-4.[illegible]
11	0.02715	0.00547	4.[illegible]
[illegible]	-0.01254	0.00334	-3.[illegible]
17	0.02347	0.00[illegible]97	3.567
INTERCEPT	[illegible].[illegible]9743		

TABLE D-1 (cont.)

STEP 1[illegible]

VARIABLE ENTERED..... 1

SUM OF SQUARES REDUCED IN THIS STEP.... 0.732
PROPORTION REDUCED IN THIS STEP.......... 0.0[illegible]1

CUMULATIVE SUM OF SQUARES REDUCED...... 1[illegible]5.[illegible]27
CUMULATIVE PROPORTION REDUCED........... 0.092 OF 1154.13[illegible]

FOR 1[illegible] VARIABLES ENTERED
MULTIPLE CORRELATION COEFFICIENT... 0.3[illegible]3
(ADJUSTED FOR D.F.)........... 0.3[illegible]2
F-VALUE FOR ANALYSIS OF VARIANCE... 170.4[illegible]6
STANDARD ERROR OF ESTIMATE......... 0.249
(ADJUSTED FOR D.F.)............ 0.249

VARIABLE NUMBER	REGRESSION COEFFICIENT	STD. ERROR OF REG. COEFF.	COMPUTED T-VALUE
22	0.0[illegible]29[illegible]	0.0[illegible]06	15.[illegible]45
1[illegible]	-0.02723	0.00488	-5.533
1[illegible]	0.03967	0.00414	9.591
1[illegible]	0.01482	0.00427	3.439
4	0.0296[illegible]	0.00155	6.232
3	-0.01267	0.00279	-4.536
11	0.02804	0.00547	5.125
9	-0.01237	0.00336	-3.683
17	0.00345	0.00097	3.549
1	0.01374	0.00400	3.433
INTERCEPT	0.96761		

TABLE D-1 (cont.)

STEP 11

VARIABLE ENTERED.....25

SUM OF SQUARES REDUCED IN THIS STEP.... 0.675
PROPORTION REDUCED IN THIS STEP......... 0.001

CUMULATIVE SUM OF SQUARES REDUCED...... 106.442
CUMULATIVE PROPORTION REDUCED........... 0.0[illegible]2 OF 1134.135

FOR 11 VARIABLES ENTERED
MULTIPLE CORRELATION COEFFICIENT... 0.3[illegible]4
(ADJUSTED FOR D.F.)............ 0.3[illegible]3
F-VALUE FOR ANALYSIS OF VARIANCE... 156.[illegible]11
STANDARD ERROR OF ESTIMATE......... 0.249
(ADJUSTED FOR D.F.)............ 0.24[illegible]

VARIABLE NUMBER	REGRESSION COEFFICIENT	STD. ERROR OF REG. COEFF.	COMPUTED T-VALUE
22	0.02116	0.00209	1[illegible].1[illegible]
1[illegible]	-0.02465	0.00489	-[illegible].[illegible]
1[illegible]	0.03724	0.00421	[illegible].[illegible]41
1[illegible]	0.01301	0.00411	3.[illegible]
4	0.03981	0.00155	[illegible].31[illegible]
3	-0.0127[illegible]	0.00279	-4.[illegible]47
11	0.027[illegible]	0.00549	4.[illegible]
9	-0.01225	0.00335	-[illegible].[illegible]2
17	0.00359	0.00097	3.[illegible]
1	0.0141[illegible]	0.00402	3.[illegible]
25	-0.0005[illegible]	0.00[illegible]18	-[illegible].[illegible]
INTERCEPT	[illegible].06952		

TABLE D-1 (cont.)

STEP 12

VARIABLE ENTERED.....21

SUM OF SQUARES REDUCED IN THIS STEP.... 0.377
PROPORTION REDUCED IN THIS STEP........ 0.313

CUMULATIVE SUM OF SQUARES REDUCED...... 116.133
CUMULATIVE PROPORTION REDUCED.......... 0.323 OF 1164.135

FOR 12 VARIABLES ENTERED
MULTIPLE CORRELATION COEFFICIENT... 0.324
(ADJUSTED FOR D.F.)........... 0.313
F-VALUE FOR ANALYSIS OF VARIANCE... 143.5[illegible]
STANDARD ERROR OF ESTIMATE......... 0.249
(ADJUSTED FOR D.F.)........... 0.249

VARIABLE NUMBER	REGRESSION COEFFICIENT	STD. ERROR OF REG. COEFF.	COMPUTED T-VALUE
22	[illegible].[illegible]2115	[illegible].[illegible]0[illegible]09	13.193
14	-[illegible].[illegible]251[illegible]	0.[illegible]0492	-5.[illegible]
13	[illegible].[illegible]3692	0.[illegible]0421	[illegible].754
1[illegible]	[illegible].[illegible]163[illegible]	[illegible].[illegible]0432	3.78[illegible]
4	[illegible].[illegible]1[illegible]11	0.[illegible]0156	5.452
3	-[illegible].[illegible]1357	[illegible].[illegible]0281	-4.[illegible]2[illegible]
11	[illegible].[illegible]2644	0.[illegible]0548	4.[illegible]27
9	-[illegible].[illegible]1246	0.[illegible]0336	-3.714
17	[illegible].[illegible]236[illegible]	0.[illegible]0297	3.7[illegible]
1	[illegible].[illegible]1354	[illegible].[illegible]0401	3.3[illegible]
25	-[illegible].[illegible]0257	0.[illegible]0018	-3.1[illegible]
21	-[illegible].[illegible]0001	0.[illegible]0004	-2.[illegible]
INTERCEPT	[illegible].[illegible]6800		

TABLE D-1 (cont.)

STEP 13

VARIABLE ENTERED.....2[illegible]

SUM OF SQUARES REDUCED IN THIS STEP.... 0.939
PROPORTION REDUCED IN THIS STEP........ 0.[illegible]11

CUMULATIVE SUM OF SQUARES REDUCED...... 1[illegible]7.7[illegible]2
CUMULATIVE PROPORTION REDUCED.......... [illegible].2[illegible]3 OF 1154.135

FOR 13 VARIABLES ENTERED
MULTIPLE CORRELATION COEFFICIENT... 0.3[illegible]6
(ADJUSTED FOR D.F.)............ 0.3[illegible]5
F-VALUE FOR ANALYSIS OF VARIANCE... 1[illegible]3.[illegible]1[illegible]
STANDARD ERROR OF ESTIMATE......... 0.24[illegible]
(ADJUSTED FOR D.F.)............ 0.24[illegible]

VARIABLE NUMBER	REGRESSION COEFFICIENT	STD. ERROR OF REG. COEFF.	COMPUTED T-VALUE
22	[illegible].[illegible]011[illegible]	0.0[illegible]29	13.[illegible]7[illegible]
1[illegible]	-0.02615	0.[illegible]0493	-[illegible].[illegible]7
1[illegible]	[illegible].03682	0.[illegible]0421	[illegible].742
1[illegible]	[illegible].[illegible]146[illegible]	0.[illegible]0434	[illegible].[illegible]
4	[illegible].[illegible]0996	0.[illegible]0156	6.392
3	-0.01679	0.[illegible]0293	-5.72[illegible]
11	[illegible].[illegible]2686	0.[illegible]0549	4.[illegible]
7	-[illegible].[illegible]124[illegible]	0.[illegible]033[illegible]	-3.72[illegible]
17	[illegible].[illegible]0364	[illegible].[illegible]0097	3.7[illegible]7
1	[illegible].[illegible]	0.[illegible]0424	1.[illegible]5
25	-[illegible].[illegible]56	0.[illegible]19	-3.[illegible]47
21	-[illegible].[illegible]2[illegible]0[illegible]	0.[illegible]0[illegible]	-4.[illegible]9
2[illegible]	[illegible].[illegible]02[illegible]	0.[illegible]0025	3.[illegible]9[illegible]
INTERCEPT	0.10053		

TABLE D-1 (cont.)

STEP 14

VARIABLE ENTERED..... 2

SUM OF SQUARES REDUCED IN THIS STEP.... 0.428
PROPORTION REDUCED IN THIS STEP........ 0.[illegible]

CUMULATIVE SUM OF SQUARES REDUCED...... 108.22[illegible]
CUMULATIVE PROPORTION REDUCED.......... 0.[illegible]94 OF 1134.1[illegible]

FOR 14 VARIABLES ENTERED
MULTIPLE CORRELATION COEFFICIENT... 0.3[illegible]
(ADJUSTED FOR D.F.)........... 0.3[illegible]
F-VALUE FOR ANALYSIS OF VARIANCE... 124.7[illegible]
STANDARD ERROR OF ESTIMATE......... 0.24[illegible]
(ADJUSTED FOR D.F.)........... 0.24[illegible]

VARIABLE NUMBER	REGRESSION COEFFICIENT	STD. ERROR OF REG. COEFF.	COMPUTED T-VALUE
22	[illegible].[illegible]2113	0.[illegible]0[illegible]9	12.[illegible]
1[illegible]	-[illegible].[illegible]2474	0.[illegible]0496	-4.[illegible]96
1[illegible]	[illegible].[illegible]3742	0.[illegible]042[illegible]	3.[illegible]73
1[illegible]	[illegible].[illegible]139[illegible]	0.[illegible]043[illegible]	3.[illegible]
[illegible]	[illegible].[illegible]1[illegible]	0.[illegible]0156	6.[illegible]5[illegible]
[illegible]	-[illegible].[illegible]2[illegible]26	0.[illegible]0321	-6.[illegible]4
11	[illegible].[illegible]2681	0.[illegible]054[illegible]	4.[illegible]
[illegible]	-[illegible].[illegible]124[illegible]	0.[illegible]0335	-3.7[illegible]
17	[illegible].[illegible]2361	0.[illegible]0[illegible]97	3.712
1	[illegible].[illegible]111[illegible]	0.[illegible]044[illegible]	2.[illegible]3[illegible]
25	-[illegible].[illegible]0752	0.[illegible]0[illegible]1[illegible]	-2.[illegible]63
21	-[illegible].[illegible]0[illegible]2	0.[illegible]0[illegible]01	-3.[illegible]3[illegible]
2[illegible]	[illegible].[illegible]0[illegible]34	0.[illegible]0[illegible]0[illegible]	4.[illegible]25
2	-[illegible].[illegible]0[illegible]01	0.[illegible]0[illegible]0[illegible]	-2.63[illegible]
INTERCEPT	[illegible].1141[illegible]		

STEP 15

VARIABLE ENTERED.....12

SUM OF SQUARES REDUCED IN THIS STEP.... 0.311
PROPORTION REDUCED IN THIS STEP........ 0.000

CUMULATIVE SUM OF SQUARES REDUCED...... 108.531
CUMULATIVE PROPORTION REDUCED.......... 0.094 OF 1154.16[illegible]

FOR 15 VARIABLES ENTERED
MULTIPLE CORRELATION COEFFICIENT... 0.307
(ADJUSTED FOR D.F.)........... 0.305
F-VALUE FOR ANALYSIS OF VARIANCE... 116.534
STANDARD ERROR OF ESTIMATE......... 0.249
(ADJUSTED FOR D.F.)........... 0.249

VARIABLE NUMBER	REGRESSION COEFFICIENT	STD. ERROR OF REG. COEFF.	COMPUTED T-VALUE
22	0.00115	0.00009	12.971
1[illegible]	-0.02574	0.00497	-5.175
1[illegible]	0.03148	0.00498	6.321
1[illegible]	0.01491	0.00437	3.4[illegible]3
4	0.0109[illegible]	0.0016[illegible]	6.[illegible]1
3	-0.01998	0.00322	-6.215
11	0.0243[illegible]	0.00550	4.[illegible]46
9	-0.01237	0.00335	-3.689
17	0.0043[illegible]	0.00096	4.[illegible]51
1	0.01142	0.0044[illegible]	2.593
25	-0.00259	0.0001[illegible]	-3.175
21	-0.00002	0.00001	-2.[illegible]7
27	0.00035	0.00008	4.335
2	-0.00021	0.00008	-2.657
12	0.00035	0.00016	2.261
INTERCEPT	0.10457		

TABLE D-1 (cont.)

STEP 16

VARIABLE ENTERED..... 7

SUM OF SQUARES REDUCED IN THIS STEP....	0.379
PROPORTION REDUCED IN THIS STEP........	0.000
CUMULATIVE SUM OF SQUARES REDUCED......	1[illegible]8.91[illegible]
CUMULATIVE PROPORTION REDUCED..........	0.[illegible]74 OF 1154.135

FOR 16 VARIABLES ENTERED

MULTIPLE CORRELATION COEFFICIENT...	0.3[illegible]7
(ADJUSTED FOR D.F.)............	0.3[illegible]6
F-VALUE FOR ANALYSIS OF VARIANCE...	1[illegible]9.948
STANDARD ERROR OF ESTIMATE.........	0.249
(ADJUSTED FOR D.F.)............	0.249

VARIABLE NUMBER	REGRESSION COEFFICIENT	STD. ERROR OF REG. COEFF.	COMPUTED T-VALUE
22	0.[illegible]2115	0.[illegible]	12.[illegible]71
14	-0.02332	0.00507	-4.60[illegible]
15	0.03359	0.00499	6.12[illegible]
19	0.01302	0.00444	2.[illegible]32
4	0.01023	0.00163	6.[illegible]93
3	-0.02279	0.00323	-6.433
11	0.02462	0.00559	4.435
9	-0.01151	0.00337	-3.415
17	0.00401	0.00[illegible]99	4.[illegible]61
1	0.01134	0.00442	2.375
25	-0.00059	0.00[illegible]19	-3.167
21	-0.00002	0.00[illegible]01	-3.[illegible]28
20	0.00037	0.000[illegible]	4.509
2	-0.03301	0.000[illegible]	-2.603
12	0.00040	0.00016	2.547
7	0.01151	0.00465	2.474
INTERCEPT	0.09[illegible]		

TABLE D-1 (cont.)

STEP 27

VARIABLE ENTERED..... 5

SUM OF SQUARES REDUCED IN THIS STEP.... 0.313
PROPORTION REDUCED IN THIS STEP........ 0.000

CUMULATIVE SUM OF SQUARES REDUCED...... 110.339
CUMULATIVE PROPORTION REDUCED.......... 0.096 OF 1154.135

FOR 27 VARIABLES ENTERED
MULTIPLE CORRELATION COEFFICIENT... 0.310
(ADJUSTED FOR D.F.)........... 0.307
F-VALUE FOR ANALYSIS OF VARIANCE... 46.056
STANDARD ERROR OF ESTIMATE......... 0.249
(ADJUSTED FOR D.F.)........... 0.249

VARIABLE NUMBER	REGRESSION COEFFICIENT	STD. ERROR OF REG. COEFF.	COMPUTED T-VALUE
22	0.00136	0.00013	11.163
18	-0.02351	0.00502	-4.682
15	0.03186	0.00590	5.397
10	0.01049	0.00454	2.310
4	0.00981	0.00197	4.975
3	-0.02039	0.00326	-6.243
11	0.02684	0.00587	4.422
9	-0.01117	0.00338	-3.303
17	0.00427	0.00147	2.906
1	0.01033	0.00442	2.337
25	-0.00074	0.00025	-3.044
21	-0.00082	0.00021	-3.114
20	0.00036	0.00008	4.341
2	-0.00021	0.00008	-2.696
12	0.00031	0.00018	1.725
7	0.02157	0.00597	3.613
8	-0.01723	0.00569	-3.031
26	0.00026	0.00016	1.434
24	-0.00011	0.00008	-1.415
14	-0.00028	0.00012	-2.341
16	0.00252	0.00119	2.118
6	-0.00432	0.00425	-1.016
13	0.00017	0.00018	0.916
19	-0.00100	0.00133	-0.754
23	0.00006	0.00008	0.720
27	-0.00004	0.00008	-0.562
5	-0.00138	0.00602	-0.229
INTERCEPT	0.11458		

TABLE D-2. VARIABLES USED FOR VOLUME LINEAR REGRESSION MODEL

STEP-WISE MULTIPLE REGRESSION.....VOLUME

NUMBER OF OBSERVATIONS22173
NUMBER OF VARIABLES 6
NUMBER OF SELECTIONS 1

CONSTANT TO LIMIT VARIABLES 0.00000

VARIABLE NO.	MEAN	STANDARD DEVIATION	VARIABLE
1	1.39356	1.06509	LOG C * LOG T
2	5.45718	3.54759	LOG C ** 2
3	0.80161	0.[illegible]4164	LOG C * LOG DT
4	0.37[illegible]95	0.[illegible]6022	LOG DT
5	0.37084	0.33105	LOG N
6	0.08952	0.28550	ACC=1 NOACC=0

CORRELATION MATRIX

ROW 1	1.00000	0.36503	0.78005	0.64275	0.75581	0.26666
ROW 2	0.36503	1.00000	0.11117	-0.15990	-0.05322	0.20574
ROW 3	0.78005	0.11117	1.00000	0.90861	0.66303	0.21914
ROW 4	0.64275	-0.15990	0.90861	1.00000	0.72059	0.13931
ROW 5	0.75581	-0.05322	0.66303	0.72059	1.00000	0.16251
ROW 6	0.26666	0.20574	0.21914	0.13931	0.16251	1.00000

TABLE D-3. LINEAR REGRESSIONS COMBINING NON-VOLUME VARIABLES WITH BEST LINEAR VOLUME MODEL

VARIABLE	DESCRIPTION
3	MAIN TRACKS
4	FC
5	NRDY XING HWY
7	AADT/ (LANES + 1)
8	VOL
9	VOL*POP
10	VOL*NRBY XING HWY
20	LOG(C + 1)

where VOL is the volume equation described in B.4, Appendix B.

```
STEP 1

VARIABLE ENTERED..... 8

SUM OF SQUARES REDUCED IN THIS STEP....          103.501
PROPORTION REDUCED IN THIS STEP........            0.090

CUMULATIVE SUM OF SQUARES REDUCED......          103.501
CUMULATIVE PROPORTION REDUCED..........            0.090   CP      1154.239

FOR 1 VARIABLES ENTERED
   MULTIPLE CORRELATION COEFFICIENT...      0.299
         (ADJUSTED FOR D.F.)...........     0.299
   F-VALUE FOR ANALYSIS OF VARIANCE...   1667.365
   STANDARD ERROR OF ESTIMATE..........     0.249
         (ADJUSTED FOR D.F.)...........     0.249

   VARIABLE        REGRESSION       STD. ERROR OF       COMPUTED
    NUMBER         COEFFICIENT      REG. COEFF.         T-VALUE
      8              1.00033          0.02450            40.833
   INTERCEPT        -0.00004
```

TABLE D-3 (cont.)

STEP 2

VARIABLE ENTERED..... 10

SUM OF SQUARES REDUCED IN THIS STEP.... 6.782
PROPORTION REDUCED IN THIS STEP........ 0.006

CUMULATIVE SUM OF SQUARES REDUCED...... 110.282
CUMULATIVE PROPORTION REDUCED.......... 0.096 OF 1154.208

FOR 2 VARIABLES ENTERED
MULTIPLE CORRELATION COEFFICIENT... 0.309
(ADJUSTED FOR D.F.)........... 0.309
F-VALUE FOR ANALYSIS OF VARIANCE... 894.025
STANDARD ERROR OF ESTIMATE......... 0.248
(ADJUSTED FOR D.F.)........... 0.248

VARIABLE NUMBER	REGRESSION COEFFICIENT	STD. ERROR OF REG. COEFF.	COMPUTED T-VALUE
8	1.58142	0.06056	26.114
10	-0.52980	0.05052	-10.486
INTERCEPT	0.00429		

STEP 3

VARIABLE ENTERED..... 9

SUM OF SQUARES REDUCED IN THIS STEP.... 2.042
PROPORTION REDUCED IN THIS STEP........ 0.002

CUMULATIVE SUM OF SQUARES REDUCED...... 112.324
CUMULATIVE PROPORTION REDUCED.......... 0.097 OF 1154.208

FOR 3 VARIABLES ENTERED
MULTIPLE CORRELATION COEFFICIENT... 0.312
(ADJUSTED FOR D.F.)........... 0.312
F-VALUE FOR ANALYSIS OF VARIANCE... 608.204
STANDARD ERROR OF ESTIMATE......... 0.248
(ADJUSTED FOR D.F.)........... 0.248

VARIABLE NUMBER	REGRESSION COEFFICIENT	STD. ERROR OF REG. COEFF.	COMPUTED T-VALUE
8	1.40695	0.06766	20.794
10	-0.47305	0.05143	-9.198
9	0.05947	0.01033	5.759
INTERCEPT	0.00632		

TABLE D-3 (cont.)

STEP 4

VARIABLE ENTERED..... 3

SUM OF SQUARES REDUCED IN THIS STEP.... 1.692
PROPORTION REDUCED IN THIS STEP........ 0.001

CUMULATIVE SUM OF SQUARES REDUCED...... 114.016
CUMULATIVE PROPORTION REDUCED.......... 0.099 OF 1154.298

FOR 4 VARIABLES ENTERED
MULTIPLE CORRELATION COEFFICIENT... 0.314
(ADJUSTED FOR D.F.)............ 0.314
F-VALUE FOR ANALYSIS OF VARIANCE... 463.750
STANDARD ERROR OF ESTIMATE......... 0.248
(ADJUSTED FOR D.F.)............ 0.248

VARIABLE NUMBER	REGRESSION COEFFICIENT	STD. ERROR OF REG. COEFF.	COMPUTED T-VALUE
8	1.39460	0.06765	20.615
10	-0.49708	0.05159	-9.635
9	0.06831	0.01045	6.534
3	0.02557	0.00487	5.247
INTERCEPT	-0.01548		

STEP 5

VARIABLE ENTERED..... 7

SUM OF SQUARES REDUCED IN THIS STEP.... 0.859
PROPORTION REDUCED IN THIS STEP........ 0.001

CUMULATIVE SUM OF SQUARES REDUCED...... 114.875
CUMULATIVE PROPORTION REDUCED.......... 0.100 OF 1154.298

FOR 5 VARIABLES ENTERED
MULTIPLE CORRELATION COEFFICIENT... 0.315
(ADJUSTED FOR D.F.)............ 0.315
F-VALUE FOR ANALYSIS OF VARIANCE... 374.081
STANDARD ERROR OF ESTIMATE......... 0.248
(ADJUSTED FOR D.F.)............ 0.248

VARIABLE NUMBER	REGRESSION COEFFICIENT	STD. ERROR OF REG. COEFF.	COMPUTED T-VALUE
8	1.42520	0.06812	20.923
10	-0.50576	0.05163	-9.797
9	0.07479	0.01059	7.060
3	0.02241	0.00494	4.532
7	-0.00001	0.00000	-3.739
INTERCEPT	-0.01234		

TABLE D-3 (cont.)

STEP 6

VARIABLE ENTERED..... 4

SUM OF SQUARES REDUCED IN THIS STEP....	1.010		
PROPORTION REDUCED IN THIS STEP........	0.001		
CUMULATIVE SUM OF SQUARES REDUCED......	115.885		
CUMULATIVE PROPORTION REDUCED...........	0.100	OF	1154.299

FOR 6 VARIABLES ENTERED

MULTIPLE CORRELATION COEFFICIENT...	0.317
(ADJUSTED FOR D.F.)............	0.316
F-VALUE FOR ANALYSIS OF VARIANCE...	314.762
STANDARD ERROR OF ESTIMATE.........	0.248
(ADJUSTED FOR D.F.)............	0.248

VARIABLE NUMBER	REGRESSION COEFFICIENT	STD. ERROR OF REG. COEFF.	COMPUTED T-VALUE
8	1.37206	0.06934	19.789
10	-0.48021	0.05198	-9.238
9	0.07684	0.01060	7.249
3	0.02492	0.00498	5.004
7	-0.00001	0.00000	-4.566
4	-0.01063	0.00262	-4.057
INTERCEPT	0.04712		

TABLE D-3 (cont.)

STEP 7

VARIABLE ENTERED..... 5

SUM OF SQUARES REDUCED IN THIS STEP.... 0.878
PROPORTION REDUCED IN THIS STEP........ 0.001

CUMULATIVE SUM OF SQUARES REDUCED...... 116.763
CUMULATIVE PROPORTION REDUCED.......... 0.101 OF 1154.298

FOR 7 VARIABLES ENTERED
MULTIPLE CORRELATION COEFFICIENT... 0.318
(ADJUSTED FOR D.F.)........... 0.313
F-VALUE FOR ANALYSIS OF VARIANCE... 272.055
STANDARD ERROR OF ESTIMATE........ 0.248
(ADJUSTED FOR D.F.)........... 0.248

VARIABLE NUMBER	REGRESSION COEFFICIENT	STD. ERROR OF REG. COEFF.	COMPUTED T-VALUE
8	1.35128	0.06953	19.436
10	-0.47121	0.05202	-9.058
9	0.07713	0.01060	7.279
3	0.02544	0.00498	5.108
7	-0.00001	0.00000	-4.655
4	-0.01086	0.00262	-4.144
5	-0.01257	0.00332	-3.785
INTERCEPT	0.06855		

TABLE D-3 (cont.)

STEP 8

VARIABLE ENTERED......20

SUM OF SQUARES REDUCED IN THIS STEP.... 0.535
PROPORTION REDUCED IN THIS STEP........ 0.000

CUMULATIVE SUM OF SQUARES REDUCED...... 117.298
CUMULATIVE PROPORTION REDUCED.......... 0.102 OF 1150.298

FOR 8 VARIABLES ENTERED
MULTIPLE CORRELATION COEFFICIENT... 0.319
(ADJUSTED FOR D.F.)............ 0.318
F-VALUE FOR ANALYSIS OF VARIANCE... 239.248
STANDARD ERROR OF ESTIMATE......... 0.248
(ADJUSTED FOR D.F.)............ 0.248

VARIABLE NUMBER	REGRESSION COEFFICIENT	STD. ERROR OF REG. COEFF.	COMPUTED T-VALUE
8	1.43432	0.07498	19.130
10	-0.48848	0.05233	-9.334
9	0.07906	0.01061	7.448
3	0.01996	0.00531	3.757
7	-0.00001	0.00000	-3.697
4	-0.01349	0.00277	-4.877
5	-0.01283	0.00332	-3.861
20	-0.01232	0.00417	-2.955
INTERCEPT	0.11074		

TABLE D-4. LINEAR REGRESSIONS COMBINING NON-VOLUME VARIABLES WITH BEST LINEAR VOLUME MODEL

(Different Variables from Table D-3)

VARIABLE	DESCRIPTION
4	FC
5	NRBY XING HWY
9	VOL*POP
10	VOL*NRBY XING HWY
12	VOL/NRBY XING HWY
18	C**2/(LANES + 1)
19	VOL**2
22	LOG(VOL**2)

where VOL is the volume equation described in B.4, Appendix B.

```
STEP  1

VARIABLE ENTERED.....12

SUM OF SQUARES REDUCED IN THIS STEP....        110.058
PROPORTION REDUCED IN THIS STEP........          0.095

CUMULATIVE SUM OF SQUARES REDUCED......        110.058
CUMULATIVE PROPORTION REDUCED..........          0.095   OF      1154.298

FOR  1 VARIABLES ENTERED
  MULTIPLE CORRELATION COEFFICIENT...       0.309
       (ADJUSTED FOR D.F.)...........       0.309
  F-VALUE FOR ANALYSIS OF VARIANCE...    1783.992
  STANDARD ERROR OF ESTIMATE.........       0.248
       (ADJUSTED FOR D.F.)...........       0.248

  VARIABLE      REGRESSION      STD. ERROR OF      COMPUTED
   NUMBER       COEFFICIENT      REG. COEFF.       T-VALUE
    12            1.36694         0.03236           42.237
  INTERCEPT       0.26318
```

TABLE D-4 (cont.)

STEP 2

VARIABLE ENTERED..... 9

SUM OF SQUARES REDUCED IN THIS STEP....	2.083		
PROPORTION REDUCED IN THIS STEP........	0.002		
CUMULATIVE SUM OF SQUARES REDUCED......	112.134		
CUMULATIVE PROPORTION REDUCED..........	0.497	OF	1154.298

FOR 2 VARIABLES ENTERED

MULTIPLE CORRELATION COEFFICIENT...	0.312
(ADJUSTED FOR D.F.)...........	0.312
F-VALUE FOR ANALYSIS OF VARIANCE...	910.645
STANDARD ERROR OF ESTIMATE.........	0.248
(ADJUSTED FOR D.F.)...........	0.248

VARIABLE NUMBER	REGRESSION COEFFICIENT	STD. ERROR OF REG. COEFF.	COMPUTED T-VALUE
12	1.21243	0.04184	28.976
9	0.06006	0.01232	5.317
INTERCEPT	0.00531		

STEP 3

VARIABLE ENTERED.....18

SUM OF SQUARES REDUCED IN THIS STEP....	1.840		
PROPORTION REDUCED IN THIS STEP........	0.002		
CUMULATIVE SUM OF SQUARES REDUCED......	113.973		
CUMULATIVE PROPORTION REDUCED..........	0.099	OF	1154.298

FOR 3 VARIABLES ENTERED

MULTIPLE CORRELATION COEFFICIENT...	0.314
(ADJUSTED FOR D.F.)...........	0.314
F-VALUE FOR ANALYSIS OF VARIANCE...	618.112
STANDARD ERROR OF ESTIMATE.........	0.246
(ADJUSTED FOR D.F.)...........	0.248

VARIABLE NUMBER	REGRESSION COEFFICIENT	STD. ERROR OF REG. COEFF.	COMPUTED T-VALUE
12	1.29576	0.04459	29.121
9	0.07423	0.01064	6.979
18	-0.00151	0.00028	-5.471
INTERCEPT	-0.01243		

TABLE D-4 (cont.)

STEP 4

VARIABLE ENTERED..... 4

SUM OF SQUARES REDUCED IN THIS STEP.... 1.363
PROPORTION REDUCED IN THIS STEP........ 0.001

CUMULATIVE SUM OF SQUARES REDUCED...... 115.336
CUMULATIVE PROPORTION REDUCED.......... 0.100 OF 1154.298

FOR 4 VARIABLES ENTERED
MULTIPLE CORRELATION COEFFICIENT... 0.316
(ADJUSTED FOR D.F.)........... 0.316
F-VALUE FOR ANALYSIS OF VARIANCE... 469.714
STANDARD ERROR OF ESTIMATE......... 0.248
(ADJUSTED FOR D.F.)........... 0.248

VARIABLE NUMBER	REGRESSION COEFFICIENT	STD. ERROR OF REG. COEFF.	COMPUTED T-VALUE
12	1.28031	0.04459	28.714
9	0.37814	0.[illegible]1266	7.[illegible]
18	-0.02203	0.00350	-6.335
4	-0.01273	0.00270	-4.711
INTERCEPT	0.38697		

STEP 5

VARIABLE ENTERED.....22

SUM OF SQUARES REDUCED IN THIS STEP.... 0.913
PROPORTION REDUCED IN THIS STEP........ 0.001

CUMULATIVE SUM OF SQUARES REDUCED...... 116.249
CUMULATIVE PROPORTION REDUCED.......... 0.101 OF 1154.298

FOR 5 VARIABLES ENTERED
MULTIPLE CORRELATION COEFFICIENT... 0.317
(ADJUSTED FOR D.F.)........... 0.317
F-VALUE FOR ANALYSIS OF VARIANCE... 379.066
STANDARD ERROR OF ESTIMATE......... 0.248
(ADJUSTED FOR D.F.)........... 0.248

VARIABLE NUMBER	REGRESSION COEFFICIENT	STD. ERROR OF REG. COEFF.	COMPUTED T-VALUE
12	1.[illegible]2113	0.[illegible]8499	11.7[illegible]
9	0.36587	0.[illegible]1112	5.[illegible]7
19	-0.02197	0.00330	-6.[illegible]
4	-0.01325	0.00271	-4.[illegible]
22	0.73317	0.19002	3.859
INTERCEPT	0.4789[illegible]		

TABLE D-4 (cont.)

STEP 6

VARIABLE ENTERED.....19

SUM OF SQUARES REDUCED IN THIS STEP....	0.968
PROPORTION REDUCED IN THIS STEP........	0.001

CUMULATIVE SUM OF SQUARES REDUCED......	117.217		
CUMULATIVE PROPORTION REDUCED..........	0.102	OF	1154.298

FOR 6 VARIABLES ENTERED

MULTIPLE CORRELATION COEFFICIENT...	0.319
(ADJUSTED FOR D.F.)............	0.31[illegible]
F-VALUE FOR ANALYSIS OF VARIANCE...	316.7[illegible]
STANDARD ERROR OF ESTIMATE.........	0.246
(ADJUSTED FOR D.F.)............	0.24[illegible]

VARIABLE NUMBER	REGRESSION COEFFICIENT	STD. ERROR OF REG. COEFF.	COMPUTED T-VALUE
12	0.75094	0.10573	7.102
9	0.06989	0.01117	6.259
18	-0.00195	0.0003[illegible]	-6.562
4	-0.01364	0.00271	-5.[illegible]
22	5.5782[illegible]	1.2338[illegible]	4.[illegible]21
17	-5.48395	1.37983	-3.974
INTERCEPT	3.0149[illegible]		

TABLE D-4 (cont.)

STEP 7

VARIABLE ENTERED..... 5

SUM OF SQUARES REDUCED IN THIS STEP.... 0.937
PROPORTION REDUCED IN THIS STEP........ 0.001

CUMULATIVE SUM OF SQUARES REDUCED...... 118.154
CUMULATIVE PROPORTION REDUCED.......... 0.102 OF 1154.298

FOR 7 VARIABLES ENTERED
MULTIPLE CORRELATION COEFFICIENT... 0.320
(ADJUSTED FOR D.F.)............ 0.319
F-VALUE FOR ANALYSIS OF VARIANCE... 275.665
STANDARD ERROR OF ESTIMATE......... 0.247
(ADJUSTED FOR D.F.)............ 0.247

VARIABLE NUMBER	REGRESSION COEFFICIENT	STD. ERROR OF REG. COEFF.	COMPUTED T-VALUE
12	0.72685	0.10587	6.865
9	0.86971	0.21114	6.245
13	-0.00199	0.00030	-6.492
4	-0.01391	0.00271	-5.141
22	5.60564	1.23337	4.545
19	-5.48273	1.37925	-3.975
5	-0.01299	0.00332	-3.912
INTERCEPT	3.25248		

TABLE D-4 (cont.)

STEP 5

VARIABLE ENTERED.....12

SUM OF SQUARES REDUCED IN THIS STEP.... 0.599
PROPORTION REDUCED IN THIS STEP........ 0.001

CUMULATIVE SUM OF SQUARES REDUCED...... 118.753
CUMULATIVE PROPORTION REDUCED.......... 0.103 OF 1154.298

FOR 8 VARIABLES ENTERED
MULTIPLE CORRELATION COEFFICIENT... 0.321
(ADJUSTED FOR D.F.)............ 0.320
F-VALUE FOR ANALYSIS OF VARIANCE... 242.555
STANDARD ERROR OF ESTIMATE......... 0.247
(ADJUSTED FOR D.F.)............ 0.247

VARIABLE NUMBER	REGRESSION COEFFICIENT	STD. ERROR OF REG. COEFF.	COMPUTED T-VALUE
12	0.75952	0.10635	7.141
9	0.06678	0.01120	5.963
18	-0.00194	0.00033	-6.925
4	-0.31327	0.20271	-4.192
22	6.80342	1.29127	5.273
19	-6.63985	1.42765	-4.651
5	-0.01282	0.00332	-3.961
13	-0.11629	0.03718	-3.128
INTERCEPT	3.67821		

TABLE D-5. ILLUSTRATION OF "MIGRATION" AND CONVERGENCE-SUCCESSIVE ITERATIONS

STEP 4

VARIABLE ENTERED..... 4

SUM OF SQUARES REDUCED IN THIS STEP.... 2.94432
PROPORTION REDUCED IN THIS STEP........ 0.00032

CUMULATIVE SUM OF SQUARES REDUCED...... 5204.70934
CUMULATIVE PROPORTION REDUCED.......... 0.57455 OF 9058.69676

FOR 4 VARIABLES ENTERED
MULTIPLE CORRELATION COEFFICIENT... 0.75799
(ADJUSTED FOR D.F.)........... 0.75796
F-VALUE FOR ANALYSIS OF VARIANCE... 7484.323
STANDARD ERROR OF ESTIMATE......... 0.417
(ADJUSTED FOR D.F.)........... 0.41699

VARIABLE NUMBER	REGRESSION COEFFICIENT	STD. ERROR OF REG. COEFF.	COMPUTED T-VALUE	
2	0.53884E+00	0.09136	5.890	H (OF VIT16)
3	-0.46455E+00	0.09847	-4.718	H**2
1	-0.11535E+00	0.02647	-4.358	1
4	-0.12980E+00	0.03154	-4.115	H**3
INTERCEPT	-0.00308			

TOLERANCE = .29440E+01

STEP 4

VARIABLE ENTERED..... 1

SUM OF SQUARES REDUCED IN THIS STEP.... 4.28890
PROPORTION REDUCED IN THIS STEP........ 0.00047

CUMULATIVE SUM OF SQUARES REDUCED...... 5165.23438
CUMULATIVE PROPORTION REDUCED.......... 0.57147 OF 9038.48914

FOR 4 VARIABLES ENTERED
MULTIPLE CORRELATION COEFFICIENT... 0.75596
(ADJUSTED FOR D.F.)........... 0.75592
F-VALUE FOR ANALYSIS OF VARIANCE... 7390.614
STANDARD ERROR OF ESTIMATE......... 0.418
(ADJUSTED FOR D.F.)........... 0.41803

VARIABLE NUMBER	REGRESSION COEFFICIENT	STD. ERROR OF REG. COEFF.	COMPUTED T-VALUE	
2	0.44127E+00	0.08936	4.955	H (OF VIT16)
3	-0.58231E+00	0.09457	-6.158	H**2
4	-0.16537E+00	0.02983	-5.541	H**3
1	-0.13027E+00	0.02629	-4.954	1
INTERCEPT	0.00005			

TOLERANCE = .42889E+01

STEP 4

VARIABLE ENTERED..... 1

SUM OF SQUARES REDUCED IN THIS STEP.... 4.55172
PROPORTION REDUCED IN THIS STEP........ 0.00051

CUMULATIVE SUM OF SQUARES REDUCED...... 5125.97827
CUMULATIVE PROPORTION REDUCED.......... 0.56965 OF 8998.48193

FOR 4 VARIABLES ENTERED
MULTIPLE CORRELATION COEFFICIENT... 0.75475
(ADJUSTED FOR D.F.)............ 0.75471
F-VALUE FOR ANALYSIS OF VARIANCE... 7335.867
STANDARD ERROR OF ESTIMATE......... 0.418
(ADJUSTED FOR D.F.)............ 0.41799

VARIABLE NUMBER	REGRESSION COEFFICIENT	STD. ERROR OF REG. COEFF.	COMPUTED T-VALUE	
2	0.2278[illegible]E+00	0.[illegible]8861	4.602	H (OF VIT16)
3	-0.62319E+00	0.[illegible]9356	-6.714	H**2
4	-0.17961E+00	0.[illegible]2933	-6.123	H**3
1	-0.13417E+00	0.02629	-5.105	1
INTERCEPT	0.00005			

TOLERANCE = .45517E+01

STEP 4

VARIABLE ENTERED..... 1

SUM OF SQUARES REDUCED IN THIS STEP.... 4.64733
PROPORTION REDUCED IN THIS STEP........ 0.00052

CUMULATIVE SUM OF SQUARES REDUCED...... 5097.06598
CUMULATIVE PROPORTION REDUCED.......... 0.56859 OF 8964.42395

FOR 4 VARIABLES ENTERED
MULTIPLE CORRELATION COEFFICIENT... 0.75405
(ADJUSTED FOR D.F.)............ 0.75401
F-VALUE FOR ANALYSIS OF VARIANCE... 73[illegible]4.196
STANDARD ERROR OF ESTIMATE......... 0.418
(ADJUSTED FOR D.F.)............ 0.41771

VARIABLE NUMBER	REGRESSION COEFFICIENT	STD. ERROR OF REG. COEFF.	COMPUTED T-VALUE	
2	0.39386E+00	0.[illegible]8838	4.457	H (OF VIT16)
3	-0.64[illegible]9[illegible]E+00	0.[illegible]9313	-6.[illegible]63	H**2
4	-0.186[illegible]7E+00	0.[illegible]2912	-6.389	H**3
1	-0.13555E+00	0.[illegible]2626	-5.161	1
INTERCEPT	0.00004			

TOLERANCE = .46473E+01

TABLE D-5 (cont.)

STEP 4

VARIABLE ENTERED...... 1

SUM OF SQUARES REDUCED IN THIS STEP.... 4.72331
PROPORTION REDUCED IN THIS STEP........ 0.00053

CUMULATIVE SUM OF SQUARES REDUCED...... 5076.95208
CUMULATIVE PROPORTION REDUCED.......... 0.56792 OF 8939.52539

FOR 4 VARIABLES ENTERED
MULTIPLE CORRELATION COEFFICIENT... 0.75361
(ADJUSTED FOR D.F.)............ 0.75357
F-VALUE FOR ANALYSIS OF VARIANCE... 7254.337
STANDARD ERROR OF ESTIMATE......... 0.417
(ADJUSTED FOR D.F.)............ 0.41745

VARIABLE NUMBER	REGRESSION COEFFICIENT	STD. ERROR OF REG. COEFF.	COMPUTED T-VALUE	
2	2.3891 E+00	0.08829	4.362	H (OF VITIF)
3	-3.66143E+00	2.09299	-7.113	H**2
4	-7.18968E+00	0.02936	-6.533	H**3
1	-2.13666E+00	0.02625	-5.207	1
INTERCEPT	0.36024			

TOLERANCE = .47233E+01

TABLE D-5 (cont.)

STEP 4

VARIABLE ENTERED...... 1

SUM OF SQUARES REDUCED IN THIS STEP.... 4.75342
PROPORTION REDUCED IN THIS STEP........ 0.00053

CUMULATIVE SUM OF SQUARES REDUCED...... 5063.00427
CUMULATIVE PROPORTION REDUCED.......... 0.56746 OF 8922.22[illegible]

FOR 4 VARIABLES ENTERED
MULTIPLE CORRELATION COEFFICIENT... 0.75333
(ADJUSTED FOR D.F.)............ 0.75326
F-VALUE FOR ANALYSIS OF VARIANCE... 727[illegible].67[illegible]
STANDARD ERROR OF ESTIMATE......... 0.417
(ADJUSTED FOR D.F.)............ 0.41727

VARIABLE NUMBER	REGRESSION COEFFICIENT	STD. ERROR OF REG. COEFF.	COMPUTED T-VALUE	
2	[illegible]	[illegible]8826	4.315	H (OF VIT16)
3	-0.66[illegible]E+00	0.[illegible]92[illegible]	-7.1[illegible]7	H**2
4	-0.19171E+0[illegible]	0.[illegible]29[illegible]4	-6.[illegible]2	H**3
1	-0.13711E+0[illegible]	0.[illegible]2624	-5.225	1
INTERCEPT	[illegible]2204			

TOLERANCE = .47534E+01

TABLE D-6. SELECTION REGRESSION -- CROSSBUCKS

STEPWISE MULTIPLE REGRESSION.....XB:SEL

NUMBER OF OBSERVATIONS [illegible]
NUMBER OF VARIABLES 19
NUMBER OF SELECTIONS 1

CONSTANT TO LIMIT VARIABLES [illegible]

VARIABLE NO.	MEAN	STANDARD DEVIATION	VARIABLE
1	[illegible]	[illegible]	LOG T
2	[illegible]	[illegible]	LOG C
3	[illegible]	[illegible]	LOG T **2
4	[illegible]	[illegible]	LOG C **2
5	[illegible]	[illegible]	[illegible]
6	[illegible]	[illegible]	LOG [illegible]
7	[illegible]	[illegible]	LOG DAY THRU
8	[illegible]	[illegible]	LOG SWITCH
9	[illegible]	[illegible]	[illegible] R=1
10	[illegible]	[illegible]	MAX SPEED
11	[illegible]	[illegible]	HWY PAVED
12	[illegible]	[illegible]	POP
13	[illegible]	[illegible]	FC
14	[illegible]	[illegible]	[illegible] HWY
15	[illegible]	[illegible]	RR ADV WARN
16	[illegible]	[illegible]	LANES
17	[illegible]	[illegible]	MAIN TRKS
18	[illegible]	[illegible]	1
19	[illegible]	[illegible]	ACC=1 NOACC=-1

TABLE D-6 (cont.)

STEP 1

VARIABLE ENTERED.......17

SUM OF SQUARES REDUCED IN THIS STEP....	4,45236		
PROPORTION REDUCED IN THIS STEP........	0,00115		
CUMULATIVE SUM OF SQUARES REDUCED......	4,45236		
CUMULATIVE PROPORTION REDUCED..........	0,00115	OF	3856,5758

FOR 1 VARIABLES ENTERED

MULTIPLE CORRELATION COEFFICIENT...	0,03397
(ADJUSTED FOR D.F.)...............	0,03397
F-VALUE FOR ANALYSIS OF VARIANCE...	25,515
STANDARD ERROR OF ESTIMATE.........	0,417
(ADJUSTED FOR D.F.)...............	0,41735

VARIABLE NUMBER	REGRESSION COEFFICIENT	STD. ERROR OF REG. COEFF.	COMPUTED T-VALUE	
17	[illegible]	0,[illegible]6530	5,[illegible]51	MAIN TRKS
INTERCEPT	-[illegible],1131			

TOLERANCE = .[illegible]E+01

STEP 2

VARIABLE ENTERED.......13

SUM OF SQUARES REDUCED IN THIS STEP....	32,87232		
PROPORTION REDUCED IN THIS STEP........	0,00852		
CUMULATIVE SUM OF SQUARES REDUCED......	37,32326		
CUMULATIVE PROPORTION REDUCED..........	0,00966	OF	3856,5758

FOR 2 VARIABLES ENTERED

MULTIPLE CORRELATION COEFFICIENT...	0,09837
(ADJUSTED FOR D.F.)...............	0,09814
F-VALUE FOR ANALYSIS OF VARIANCE...	108,316
STANDARD ERROR OF ESTIMATE.........	0,415
(ADJUSTED FOR D.F.)...............	0,41529

VARIABLE NUMBER	REGRESSION COEFFICIENT	STD. ERROR OF REG. COEFF.	COMPUTED T-VALUE	
17	0,17022E+00	0,01163	14,631	MAIN TRKS
13	-0,32746E-01	0,00237	-13,815	FC
INTERCEPT	4,[illegible]355			

TOLERANCE = .328[illegible]E+02

TABLE D-6 (cont.)

STEP 3

VARIABLE ENTERED...... 11

SUM OF SQUARES REDUCED IN THIS STEP.... 11.[illegible]
PROPORTION REDUCED IN THIS STEP........ 0.00215

CUMULATIVE SUM OF SQUARES REDUCED...... 43.33[illegible]
CUMULATIVE PROPORTION REDUCED.......... 0.01123 OF 3856.5758

FOR 3 VARIABLES ENTERED
MULTIPLE CORRELATION COEFFICIENT... 0.11194
(ADJUSTED FOR D.F.)............ 0.11154
F-VALUE FOR ANALYSIS OF VARIANCE... [illegible],772
STANDARD ERROR OF ESTIMATE......... [illegible].414
(ADJUSTED FOR D.F.)............ 0.41451

VARIABLE NUMBER	REGRESSION COEFFICIENT	STD. ERROR OF REG. COEFF.	COMPUTED T-VALUE	
17	[illegible]	0.[illegible]	14.[illegible]	MAIN TRKS
13	-[illegible]	0.[illegible]	-1[illegible]	FC
11	[illegible]	0.[illegible]	[illegible]	HWY PAVED
INTERCEPT	[illegible]759			

TOLERANCE = .11[illegible]E+02

STEP 4

VARIABLE ENTERED...... [illegible]

SUM OF SQUARES REDUCED IN THIS STEP.... 3.40733
PROPORTION REDUCED IN THIS STEP........ [illegible]

CUMULATIVE SUM OF SQUARES REDUCED...... 5[illegible].737[illegible]
CUMULATIVE PROPORTION REDUCED.......... 0.01341 OF 3856.5756

FOR 4 VARIABLES ENTERED
MULTIPLE CORRELATION COEFFICIENT... 0.11582
(ADJUSTED FOR D.F.)............ 0.11524
F-VALUE FOR ANALYSIS OF VARIANCE... 75.351
STANDARD ERROR OF ESTIMATE......... 0.414
(ADJUSTED FOR D.F.)............ 0.41434

VARIABLE NUMBER	REGRESSION COEFFICIENT	STD. ERROR OF REG. COEFF.	COMPUTED T-VALUE	
17	[illegible]	0.[illegible]114[illegible]	14.151	MAIN TRKS
13	-[illegible]-01	0.[illegible]2296	-14.492	FC
11	0.1127[illegible]	0.[illegible]12[illegible]	3.796	HWY PAVED
8	-[illegible]597[illegible]-01	0.[illegible]1474	-4.455	LOC SWITCH
INTERCEPT	0.[illegible]602			

TOLERANCE = .34[illegible]73E+01

TABLE D-6 (cont.)

STEP 5

VARIABLE ENTERED.......12

SUM OF SQUARES REDUCED IN THIS STEP....   6.17351
PROPORTION REDUCED IN THIS STEP.........   0.00190

CUMULATIVE SUM OF SQUARES REDUCED.......   57.91112
CUMULATIVE PROPORTION REDUCED...........   0.01[illegible]1 OF 3[illegible]56.[illegible]

FOR 5 VARIABLES ENTERED
MULTIPLE CORRELATION COEFFICIENT...   0.12255
(ADJUSTED FOR D.F.)...............   0.12181
F-VALUE FOR ANALYSIS OF VARIANCE...   67.5[illegible]1
STANDARD ERROR OF ESTIMATE.........   [illegible].414
(ADJUSTED FOR D.F.)................   0.414[illegible]2

VARIABLE NUMBER	REGRESSION COEFFICIENT	STD. ERROR OF REG. COEFF.	COMPUTED T-VALUE	
17	0.179[illegible]E+0[illegible]	0.[illegible]119[illegible]	14.[illegible]35	MAIN TRKS
13	-0.[illegible]524 E-01	0.[illegible]229[illegible]	-1[illegible].143	FC
21	0.[illegible]E-01	0.[illegible]1336	5.673	HVY [illegible]AVEL
[illegible]	-0.[illegible]E-01	0.01557	[illegible].163	LOC SWITCH
12	0.2234[illegible]E-01	0.0[illegible]372	6.342	PO[illegible]
INTERCEPT	-.[illegible]8678			

TOLERANCE = .5[illegible]736E+01

TABLE D-6 (cont.)

STEP 6

VARIABLE ENTERED...... 4

SUM OF SQUARES REDUCED IN THIS STEP....	4,30955	
PROPORTION REDUCED IN THIS STEP.........	0,00112	
CUMULATIVE SUM OF SQUARES REDUCED......	62,22047	
CUMULATIVE PROPORTION REDUCED...........	0,01613	OF 3856,9750

FOR 6 VARIABLES ENTERED

MULTIPLE CORRELATION COEFFICIENT...	0,127[illegible]1
(ADJUSTED FOR D.F.)............	0,12514
F-VALUE FOR ANALYSIS OF VARIANCE...	[illegible],574
STANDARD ERROR OF ESTIMATE..........	0,414
(ADJUSTED FOR D.F.)............	0,41[illegible]1

VARIABLE NUMBER	REGRESSION COEFFICIENT	STD. ERROR OF REG. COEFF.	COMPUTED T-VALUE	
17	[illegible]	0,[illegible]1173	14,[illegible]93	NET. TRKS
13	-2,41[illegible]-01	0,[illegible]	-13,45[illegible]	FC
11	[illegible]	0,[illegible]1552	[illegible]	[illegible] PAVED
9	[illegible]-01	0,[illegible]1555	-[illegible]	LOG SWITCH
12	[illegible]-01	0,[illegible]411	7,[illegible]	[illegible]
4	-[illegible]7[illegible]-02	0,[illegible]0174	-5,[illegible]7	LOG C ##2
INTERCEPT	[illegible]C52[illegible]			

TOLERANCE = ,43[illegible]E+01

TABLE D-6 (cont.)

STEP 7

VARIABLE ENTERED.... 2

SUM OF SQUARES REDUCED IN THIS STEP.... 7.63773
PROPORTION REDUCED IN THIS STEP........ 0.00178

CUMULATIVE SUM OF SQUARES REDUCED....... 69.85047
CUMULATIVE PROPORTION REDUCED........... [illegible] OF 3[illegible].9755

FOR 7 VARIABLES ENTERED
MULTIPLE CORRELATION COEFFICIENT... 0.13458
(ADJUSTED FOR D.F.)............ 0.13359
F-VALUE FOR ANALYSIS OF VARIANCE... 98.4[illegible]
STANDARD ERROR OF ESTIMATE.......... [illegible].418
(ADJUSTED FOR D.F.)............ 0.41341

VARIABLE NUMBER	REGRESSION COEFFICIENT	STD. ERROR OF REG. COEFF.	COMPUTED T-VALUE	
17	[illegible]	0.[illegible]1267	12.[illegible]	MAIN TRKS
13	-[illegible]	0.[illegible]	-12.[illegible]	FC
11	[illegible]	0.[illegible]1647	5.747	[illegible] PAVED
[illegible]	-[illegible]	0.[illegible]	-5.735	LOG SWITCH
12	[illegible]	0.[illegible]415	8.445	P[illegible]
4	-[illegible]	0.[illegible]	-7.469	LOG C **2
2	[illegible].2337[illegible]	0.[illegible]	0.686	LOG C
INTERCEPT	[illegible]			

TOLERANCE = .7037[illegible]

TABLE D-6 (cont.)

STEP 8

VARIABLE ENTERED........ 15

SUM OF SQUARES REDUCED IN THIS STEP....	3.53417		
PROPORTION REDUCED IN THIS STEP.........	0.00091		
CUMULATIVE SUM OF SQUARES REDUCED......	73.35326		
CUMULATIVE PROPORTION REDUCED..........	0.019[illegible]	OF	3856.5758

FOR 8 VARIABLES ENTERED

MULTIPLE CORRELATION COEFFICIENT...	0.13792
(ADJUSTED FOR D.F.)............	0.13679
F-VALUE FOR ANALYSIS OF VARIANCE...	53.719
STANDARD ERROR OF ESTIMATE........	0.413
(ADJUSTED FOR D.F.)............	0.41324

VARIABLE NUMBER	REGRESSION COEFFICIENT	STD. ERROR OF REG. COEFF.	COMPUTED T-VALUE	
17	[illegible]E+00	0.01237	12.349	MAIN TRKS
13	-[illegible]E-01	0.0[illegible]	-12.786	FC
11	[illegible]E-02	0.01951	5.[illegible]	NEW FIXED
9	-[illegible]E-01	0.01263	-5.763	LOG SWITCH
12	[illegible]E-02	0.00415	[illegible]	P S
4	-[illegible]E-01	2.04734	-7.131	LOG C **2
2	[illegible]E+00	2.0[illegible]	5.[illegible]	LOG C
14	8.47927E-01	0.01447	4.331	LANES
INTERCEPT	4.[illegible]			

TOLERANCE = .327495+01

TABLE D-6 (cont.)

STEP 9

VARIABLE ENTERED...... 9

SUM OF SQUARES REDUCED IN THIS STEP.... 1.17265
PROPORTION REDUCED IN THIS STEP........ 0.00033

CUMULATIVE SUM OF SQUARES REDUCED...... 74.53571
CUMULATIVE PROPORTION REDUCED.......... 0.31932 OF 3556.9758

FOR 9 VARIABLES ENTERED
MULTIPLE CORRELATION COEFFICIENT... 0.13571
(ADJUSTED FOR D.F.)........... 0.1377[illegible]
F-VALUE FOR ANALYSIS OF VARIANCE... 48.527
STANDARD ERROR OF ESTIMATE......... 0.413
(ADJUSTED FOR D.F.)........... 0.41319

VARIABLE NUMBER	REGRESSION COEFFICIENT	STD. ERROR OF REG. COEFF.	COMPUTED T-VALUE	
17	0.[illegible]E+00	0.[illegible]1241	13.115	MAIN TRKS
13	-0.[illegible]E-01	0.[illegible]542	-12.[illegible]	FC
11	0.[illegible]E-01	0.[illegible]	5.[illegible]	HWY PAVED
8	-0.[illegible]E-01	0.[illegible]273	-6.[illegible]24	LOG SWITCH
12	0.28[illegible]E-01	0.[illegible]462	5.314	POP
4	-0.[illegible]847[illegible]E-01	0.[illegible]775	-7.[illegible]48	LOG C **2
2	0.21[illegible]E+00	0.[illegible]3704	5.871	LOG C
16	0.[illegible]E-01	0.[illegible]1840	4.714	LANES
9	-0.[illegible]E-01	0.21555	-2.[illegible]21	[illegible]
INTERCEPT	[illegible]3370			

TOLERANCE = .11726E+01

TABLE D-6 (cont.)

STEP 12

VARIABLE ENTERED.....10

SUM OF SQUARES REDUCED IN THIS STEP.... 1.37098
PROPORTION REDUCED IN THIS STEP......... 0.00036

CUMULATIVE SUM OF SQUARES REDUCED....... 75.90519
CUMULATIVE PROPORTION REDUCED........... 0.21960 OF 3456.5758.

FOR 12 VARIABLES ENTERED
MULTIPLE CORRELATION COEFFICIENT... 0.14[illegible]29
(ADJUSTED FOR D.F.)............. 0.13[illegible]6
F-VALUE FOR ANALYSIS OF VARIANCE... 44.491
STANDARD ERROR OF ESTIMATE.......... [illegible].413
(ADJUSTED FOR D.F.)............ 7.41[illegible]13

VARIABLE NUMBER	REGRESSION COEFFICIENT	STD. ERROR OF REG. COEFF.	COMPUTED T-VALUE	
17	0.[illegible]E+0[illegible]	0.[illegible]1354	1[illegible].379	MAIN TRKS
13	-0.[illegible]E-01	0.[illegible]646	-12.[illegible]82	FC
11	[illegible]	0.[illegible]1559	[illegible].343	HAY PAVED
3	-[illegible]E-01	0.[illegible]1579	-5.757	LOG SWITCH
12	[illegible]E-01	0.[illegible]	6.[illegible]37	P[illegible]
6	-[illegible]E-01	0.[illegible]	-7.184	LOG C [illegible]2
2	[illegible]	0.[illegible]372[illegible]	5.5[illegible]	LOG C
16	2.4[illegible]E-01	0.[illegible]10[illegible]	4.[illegible]4[illegible]	LANES
9	-[illegible]E-01	0.[illegible]	-3.[illegible]63	U[illegible]
10	0.1[illegible]E-0[illegible]	0.[illegible]038	2.434	MAX SPEED
INTERCEPT	[illegible]461			

TOLERANCE = .1[illegible]7[illegible]E+01

TABLE D-7. SELECTION REGRESSION -- FLASHING LIGHTS

STEP-WISE MULTIPLE REGRESSION.....FLSSEL

NUMBER OF OBSERVATIONS 1457.
NUMBER OF VARIABLES 20
NUMBER OF SELECTIONS 1

CONSTANT TO LIMIT VARIABLES 0.00000

VARIABLE NO.	MEAN	STANDARD DEVIATION	VARIABLE
1	0.43109	0.35112	LOG T
2	1.49172	0.87041	LOG C
3	[illegible]	0.59[illegible]55	LOG T **2
4	5.21477	3.79962	LOG C **2
5	5.62443	17.44223	T*C/5000
6	0.2931[illegible]	0.29439	LOG LITE
7	0.25977	0.26758	LOG DAY THRU
8	0.19191	0.27771	LOG SWITCH
9	0.14859	0.19996	U=0 R=1
10	13.93295	10.88436	MAX SPEED
11	0.43079	0.20659	HWY PAVED
12	7.91976	1.98612	POP
13	1.97384	0.36749	FC
14	0.22522	0.31593	RRBY XING HWY
15	0.26576	0.25872	RR ADV WARN
16	3.69179	3.46008	TRUCKS
17	1.06265	0.77095	LANES
18	0.48267	0.36666	MAIN TRKS
19	0.44061	0.19437	1
20	0.00022	0.41248	ACC=1 NOACC=-1

TABLE D-7 (cont.)

STEP 1

VARIABLE ENTERED.....13

SUM OF SQUARES REDUCED IN THIS STEP....	1.42707		
PROPORTION REDUCED IN THIS STEP........	0.00053		
CUMULATIVE SUM OF SQUARES REDUCED......	1.42707		
CUMULATIVE PROPORTION REDUCED..........	0.00053	OF	2479.80

FOR 1 VARIABLES ENTERED

MULTIPLE CORRELATION COEFFICIENT...	0.02399
(ADJUSTED FOR D.F.)............	0.02399
F-VALUE FOR ANALYSIS OF VARIANCE...	8.392
STANDARD ERROR OF ESTIMATE........	0.412
(ADJUSTED FOR D.F.)............	0.41235

VARIABLE NUMBER	REGRESSION COEFFICIENT	STD. ERROR OF REG. COEFF.	COMPUTED T-VALUE	
13	0.10325E-01	0.00364	2.897	MAIN TERM
INTERCEPT	-0.00765			

TOLERANCE = .14271E+01

STEP 2

VARIABLE ENTERED.....13

SUM OF SQUARES REDUCED IN THIS STEP....	7.17642		
PROPORTION REDUCED IN THIS STEP........	0.00289		
CUMULATIVE SUM OF SQUARES REDUCED......	8.60349		
CUMULATIVE PROPORTION REDUCED..........	0.00347	OF	2479.80

FOR 2 VARIABLES ENTERED

MULTIPLE CORRELATION COEFFICIENT...	0.05890
(ADJUSTED FOR D.F.)............	0.05832
F-VALUE FOR ANALYSIS OF VARIANCE...	25.368
STANDARD ERROR OF ESTIMATE........	0.412
(ADJUSTED FOR D.F.)............	0.41181

VARIABLE NUMBER	REGRESSION COEFFICIENT	STD. ERROR OF REG. COEFF.	COMPUTED T-VALUE	
18	0.39533E-01	0.01259	7.116	MAIN TERM
13	-0.22527E-01	0.00346	-6.505	FC
INTERCEPT	0.30153			

TOLERANCE = .71764E+01

STEP 3

TABLE D-7 (cont.)

VARIABLE ENTERED..... 3

SUM OF SQUARES REDUCED IN THIS STEP.... 2.09810
PROPORTION REDUCED IN THIS STEP........ 0.00085

CUMULATIVE SUM OF SQUARES REDUCED...... 10.70159
CUMULATIVE PROPORTION REDUCED.......... 0.00432 OF 2479.80

FOR 3 VARIABLES ENTERED
MULTIPLE CORRELATION COEFFICIENT... 0.06569
(ADJUSTED FOR D.F.)............ 0.06464
F-VALUE FOR ANALYSIS OF VARIANCE... 21.053
STANDARD ERROR OF ESTIMATE......... 0.412
(ADJUSTED FOR D.F.)............ 0.41166

VARIABLE NUMBER	REGRESSION COEFFICIENT	STD. ERROR OF REG. COEFF.	COMPUTED T-VALUE	
18	0.11192E+00	0.01409	7.941	MAIN TRKS
13	-0.18419E-01	0.00365	-5.042	FC
3	-0.32696E-01	0.00929	-3.519	LOG T **2
INTERCEPT	-0.00096			

TOLERANCE = .20981E+01

STEP 4

VARIABLE ENTERED.....12

SUM OF SQUARES REDUCED IN THIS STEP.... 1.84598
PROPORTION REDUCED IN THIS STEP........ 0.00074

CUMULATIVE SUM OF SQUARES REDUCED...... 12.54757
CUMULATIVE PROPORTION REDUCED.......... 0.00506 OF 2479.80

FOR 4 VARIABLES ENTERED
MULTIPLE CORRELATION COEFFICIENT... 0.07113
(ADJUSTED FOR D.F.)............ 0.06968
F-VALUE FOR ANALYSIS OF VARIANCE... 18.526
STANDARD ERROR OF ESTIMATE......... 0.411
(ADJUSTED FOR D.F.)............ 0.41154

VARIABLE NUMBER	REGRESSION COEFFICIENT	STD. ERROR OF REG. COEFF.	COMPUTED T-VALUE	
18	0.10825E+00	0.01413	7.660	MAIN TRKS
13	-0.23011E-01	0.00391	-5.889	FC
3	-0.3585[illegible]E-01	0.00934	-3.839	LOG T **2
12	0.12770E-01	0.00397	3.302	POP
INTERCEPT	-0.00027			

TOLERANCE = .13460E+01

TABLE D-7 (cont.)

STEP 5

VARIABLE ENTERED..... 4

SUM OF SQUARES REDUCED IN THIS STEP.... 2.12715
PROPORTION REDUCED IN THIS STEP........ 0.00086

CUMULATIVE SUM OF SQUARES REDUCED...... 14.67472
CUMULATIVE PROPORTION REDUCED.......... 0.00592 OF 2479.3[illegible]

FOR 5 VARIABLES ENTERED
MULTIPLE CORRELATION COEFFICIENT... 0.07693
(ADJUSTED FOR D.F.)........... 0.07513
F-VALUE FOR ANALYSIS OF VARIANCE... 17.347
STANDARD ERROR OF ESTIMATE........ 0.411
(ADJUSTED FOR D.F.)........... 0.41139

VARIABLE NUMBER	REGRESSION COEFFICIENT	STD. ERROR OF REG. COEFF.	COMPUTED T-VALUE	
18	0.11973E+[illegible]	0.01449	8.261	[illegible]
13	-0.16611E-01	0.00430	-3.860	PC
3	-0.37212E-01	0.00934	-3.983	LOG T **2
12	0.21117E-01	0.00453	4.665	POP
4	-0.49930E-02	0.00141	-3.546	LOG C **2
INTERCEPT	0.00056			

TOLERANCE = .21271E+01

TABLE D-7 (cont.)

STEP 6

VARIABLE ENTERED.... 17

SUM OF SQUARES REDUCED IN THIS STEP.... 5.05679
PROPORTION REDUCED IN THIS STEP........ 0.00204

CUMULATIVE SUM OF SQUARES REDUCED...... 19.73151
CUMULATIVE PROPORTION REDUCED.......... 0.00796 OF 2479.9

FOR 6 VARIABLES ENTERED
MULTIPLE CORRELATION COEFFICIENT... 0.08920
(ADJUSTED FOR D.F.)........... 0.08727
F-VALUE FOR ANALYSIS OF VARIANCE... 19.876
STANDARD ERROR OF ESTIMATE......... 0.411
(ADJUSTED FOR D.F.)........... 0.41099

VARIABLE NUMBER	REGRESSION COEFFICIENT	STD. ERROR OF REG. COEFF.	COMPUTED T-VALUE	
14	0.12161E+00	0.01448	8.397	MAIN TRKS
13	-0.19399E-01	0.00433	-4.482	FC
3	-0.37895E-01	0.00933	-4.060	LOG F **2
12	0.19636E-01	0.00453	4.334	POP
4	-0.12256E-01	0.00194	-6.338	LOG C **2
17	0.43298E-01	0.00791	5.472	LANES
INTERCEPT	-0.00120			

TOLERANCE = .50560E+01

TABLE D-7 (cont.)

STEP 7

VARIABLE ENTERED..... 7

SUM OF SQUARES REDUCED IN THIS STEP.... 1.87448
PROPORTION REDUCED IN THIS STEP........ 0.00076

CUMULATIVE SUM OF SQUARES REDUCED...... 21.60598
CUMULATIVE PROPORTION REDUCED.......... 0.00871 OF 2479.80

FOR 7 VARIABLES ENTERED
MULTIPLE CORRELATION COEFFICIENT... 0.09334
(ADJUSTED FOR D.F.)............ 0.09115
F-VALUE FOR ANALYSIS OF VARIANCE... 18.292
STANDARD ERROR OF ESTIMATE......... 0.411
(ADJUSTED FOR D.F.)............ 0.41086

VARIABLE NUMBER	REGRESSION COEFFICIENT	STD. ERROR OF REG. COEFF.	COMPUTED T-VALUE	
18	0.10540E+00	0.01527	6.901	MAIN TRKS
13	-0.22099E-01	0.00440	-5.018	FC
3	-0.62115E-01	0.01183	-5.252	LOG T **2
12	0.22907E-01	0.00463	4.943	POP
4	-0.12454E-01	0.00194	-6.435	LOG C **2
17	0.44678E-01	0.00792	5.641	LANES
7	0.83675E-01	0.02511	3.333	LOG DAY THRU
INTERCEPT	-0.00116			

TOLERANCE = .18745E+01

TABLE D-8. SELECTION REGRESSION -- AUTOMATIC GATES

STEP- THE MULTIPLE REGRESSION.....GATSEL

NUMBER OF [illegible]
NUMBER OF VARIABLES 2[illegible]
NUMBER OF SELECTIONS 1

GO START TO LIMIT VARIABLES [illegible]

VARIABLE NO.	MEAN	STANDARD DEVIATION	VARIABLE
[illegible]	[illegible]	[illegible]	LOG I
2	[illegible]	[illegible]	LOG C
3	[illegible]	[illegible]	LOG I **2
4	[illegible]	[illegible]	LOG C **2
5	[illegible]	[illegible]	I*C/S[illegible]
6	[illegible]	[illegible]	LOG SITE
7	[illegible]	[illegible]	LOG DAY THRU
8	[illegible]	[illegible]	LOG SWITCH
9	[illegible]	[illegible]	U=0 R=1
10	[illegible]	12.[illegible]	MAX SPEED
11	[illegible]	[illegible]	HWY PAVED
12	[illegible]	[illegible]	FCP
13	[illegible]	[illegible]	FC
14	[illegible]	[illegible]	NEAR KING HWY
15	[illegible]	[illegible]	RR ADV WARN
16	[illegible]	[illegible]	TRUCKS
17	[illegible]	[illegible]	LANES
18	[illegible]	[illegible]	MAIN TRKS
19	[illegible]	[illegible]	1
20	[illegible]	[illegible]	ACC=1 NOACC=-1

TABLE D-8 (cont.)

STEP 1

VARIABLE ENTERED..... [illegible]

SUM OF SQUARES REDUCED IN THIS STEP.... 1,21[illegible]
PROPORTION REDUCED IN THIS STEP........ 0,[illegible]

CUMULATIVE SUM OF SQUARES REDUCED...... 1,21[illegible]
CUMULATIVE PROPORTION REDUCED.......... [illegible] OF 653,[illegible]12

FOR 1 VARIABLE ENTERED
MULTIPLE CORRELATION COEFFICIENT... [illegible]
(ADJUSTED FOR D.F.)........... [illegible]
F-VALUE FOR ANALYSIS OF VARIANCE... 7,2[illegible]
STANDARD ERROR OF ESTIMATE......... 2,41
(ADJUSTED FOR D.F.)........... [illegible],4[illegible]2

VARIABLE NUMBER	REGRESSION COEFFICIENT	STD. ERROR OF REG. COEFF.	COMPUTED T-VALUE	
9	[illegible]	0,[illegible]939	-2,[illegible]	[illegible] =1
INTERCEPT	[illegible]			

TOLERANCE = .[illegible]

STEP 2

VARIABLE ENTERED..... 1[illegible]

SUM OF SQUARES REDUCED IN THIS STEP.... 1,[illegible]
PROPORTION REDUCED IN THIS STEP........ [illegible]

CUMULATIVE SUM OF SQUARES REDUCED...... 2,[illegible]17
CUMULATIVE PROPORTION REDUCED.......... [illegible] OF 653,[illegible]12

FOR 2 VARIABLES ENTERED
MULTIPLE CORRELATION COEFFICIENT... [illegible]74
(ADJUSTED FOR D.F.)........... [illegible]
F-VALUE FOR ANALYSIS OF VARIANCE... 7,[illegible]
STANDARD ERROR OF ESTIMATE......... [illegible]
(ADJUSTED FOR D.F.)........... [illegible],4[illegible]

VARIABLE NUMBER	REGRESSION COEFFICIENT	STD. ERROR OF REG. COEFF.	COMPUTED T-VALUE	
9	[illegible]	[illegible]17[illegible]	-3,[illegible]	[illegible]
1[illegible]	[illegible]	[illegible]	2,[illegible]	[illegible]
INTERCEPT	[illegible]			

TOLERANCE = .1[illegible]

TABLE D-8 (cont.)

STEP 3

VARIABLE ENTERED.....13

SUM OF SQUARES REDUCED IN THIS STEP.... 2.76436
PROPORTION REDUCED IN THIS STEP........ 0.00423

CUMULATIVE SUM OF SQUARES REDUCED...... 5.33513
CUMULATIVE PROPORTION REDUCED.......... 0.00816 OF 653.87129

FOR 3 VARIABLES ENTERED
MULTIPLE CORRELATION COEFFICIENT... 0.09036
(ADJUSTED FOR D.F.)............... 0.[illegible]743
F-VALUE FOR ANALYSIS OF VARIANCE... 10.[illegible]7
STANDARD ERROR OF ESTIMATE......... 2.[illegible]
(ADJUSTED FOR D.F.)............... 0.42573

VARIABLE NUMBER	REGRESSION COEFFICIENT	STD. ERROR OF REG. COEFF.	COMPUTED T-VALUE	
9	-0.[illegible]E-01	0.03261	-2.374	USE F=1
10	0.[illegible]E-01	0.01763	4.024	MAIN TRKS
13	-0.[illegible]E-01	0.02650	-4.[illegible]	FC
INTERCEPT	[illegible]83			

TOLERANCE = .27641E+01

STEP 4

VARIABLE ENTERED.....5

SUM OF SQUARES REDUCED IN THIS STEP.... 1.19759
PROPORTION REDUCED IN THIS STEP........ 0.00113

CUMULATIVE SUM OF SQUARES REDUCED...... 6.53279
CUMULATIVE PROPORTION REDUCED.......... 0.[illegible] OF 653.87128

FOR 4 VARIABLES ENTERED
MULTIPLE CORRELATION COEFFICIENT... 0.09994
(ADJUSTED FOR D.F.)............... 0.[illegible]
F-VALUE FOR ANALYSIS OF VARIANCE... 9.8[illegible]1
STANDARD ERROR OF ESTIMATE......... 0.4[illegible]
(ADJUSTED FOR D.F.)............... 0.42646

VARIABLE NUMBER	REGRESSION COEFFICIENT	STD. ERROR OF REG. COEFF.	COMPUTED T-VALUE	
9	-0.[illegible]E-01	0.03319	-2.369	USE F=1
10	0.[illegible]E-01	0.01911	5.[illegible]1	MAIN TRKS
13	-0.[illegible]E-01	0.[illegible]	-1.[illegible]	FC
5	-0.[illegible]E-0[illegible]	0.[illegible]	-2.[illegible]	T[illegible]
INTERCEPT	[illegible]397			

TOLERANCE = .119[illegible]E+01

TABLE D-8 (cont.)

STEP 5

VARIABLE ENTERED........ 17

SUM OF SQUARES REDUCED IN THIS STEP.......... 1,6[illegible]41
PROPORTION REDUCED IN THIS STEP.......... 0,00215

CUMULATIVE SUM OF SQUARES REDUCED.......... 5,13979
CUMULATIVE PROPORTION REDUCED.......... 0,01245 OF 4[illegible]3,[illegible]712

FOR 5 VARIABLES ENTERED
MULTIPLE CORRELATION COEFFICIENT... 0,11157
(ADJUSTED FOR D.F.)........ 0,1[illegible]92
F-VALUE FOR ANALYSIS OF VARIANCE... 9,7[illegible]7
STANDARD ERROR OF ESTIMATE........ [illegible]
(ADJUSTED FOR D.F.)........ [illegible]

VARIABLE NUMBER	REGRESSION COEFFICIENT	STD. ERROR OF REG. COEFF.	COMPUTED T-VALUE	
[illegible]	-[illegible],[illegible]997[illegible]E-01	0,[illegible]3[illegible]15	-3,[illegible]84	UFS [illegible]=1
19	[illegible]E-[illegible]	0,[illegible]193[illegible]	2,[illegible]55	MAIN TRKS
13	-[illegible],41[illegible]E-01	0,[illegible]7[illegible]5	-5,[illegible]	FL
[illegible]	-[illegible]E-0[illegible]	0,[illegible]02[illegible]	-3,667	[illegible]
17	[illegible],[illegible]91[illegible]E-01	0,[illegible]1125	3,195	LANES
INTERCEPT	[illegible]2977			

TOLLERANCE = .1[illegible] 40E+71

TABLE D-8 (cont.)

STEP 6

VARIABLE ENTERED...... 4

SUM OF SQUARES REDUCED IN THIS STEP.... 2.04190
PROPORTION REDUCED IN THIS STEP........ 0.00312

CUMULATIVE SUM OF SQUARES REDUCED...... 10.15048
CUMULATIVE PROPORTION REDUCED.......... 0.01537 OF 663.2712

FOR 6 VARIABLES ENTERED
MULTIPLE CORRELATION COEFFICIENT... 0.12473
(ADJUSTED FOR D.F.)................ 0.11259
F-VALUE FOR ANALYSIS OF VARIANCE... 10.231
STANDARD ERROR OF ESTIMATE......... 0.827
(ADJUSTED FOR D.F.)................ 0.82752

VARIABLE NUMBER	REGRESSION COEFFICIENT	STD. ERROR OF REG. COEFF.	COMPUTED T-VALUE	
9	-0.[illegible]E+00	0.03513	-3.139	USE R=1
11	0.[illegible]E+00	0.01956	5.629	MAIN TRKS
13	-0.[illegible]277E-01	0.00383	-3.771	FG
5	-0.[illegible]E-03	0.02025	-2.146	TOC/S[illegible]
17	0.[illegible]E-01	0.01958	4.651	LATER
4	-0.13109E-01	0.03374	-3.[illegible]	LOG C ##2
INTERCEPT	-.0237			

TOLERANCE = .2-4[illegible]E+01

TABLE D-8 (cont.)

STEP 7

VARIABLE [illegible]

SUM OF [illegible] THIS STEP........ 2.53273
PROPORTION [illegible] THIS STEP......... [illegible]

CUMULATIVE [illegible]...... [illegible].71041
CUMULATIVE [illegible]........... [illegible] OF [illegible]

[illegible]
[illegible]... [illegible].12[illegible]
[illegible]............... [illegible]
[illegible]... 9.23[illegible]
[illegible]............. [illegible]
[illegible]............. 0.4[illegible]745

VARIABLE NUMBER	[illegible] COEFFICIENT	STD. ERROR OF REG. COEFF.	COMPUTED T-VALUE	
9	[illegible]	[illegible]	-2.[illegible]	[illegible]
[illegible]	[illegible]	0.[illegible]	5.[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	-3.[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	-2.11[illegible]	[illegible]
17	[illegible]	[illegible]	4.[illegible]	[illegible]
4	[illegible]	0.[illegible]	-2.[illegible]	[illegible]
15	[illegible]	0.[illegible]2862	-1.79[illegible]	[illegible] ADV [illegible]
INTERCEPT	[illegible]			

TOLERANCE = .[illegible]573E+[illegible]

TABLE D-8 (cont.)

STEP 8

VARIABLE ENTERED........19

SUM OF SQUARES REDUCED IN THIS STEP....	0,55937			
PROPORTION REDUCED IN THIS STEP........	0,00036			
CUMULATIVE SUM OF SQUARES REDUCED......	11,27575			
CUMULATIVE PROPORTION REDUCED..........	0,01724	OF	653,[illegible]	
FOR 8 VARIABLES ENTERED				
MULTIPLE CORRELATION COEFFICIENT...	0,13132			
(ADJUSTED FOR D.F.)............	0,12439			
F-VALUE FOR ANALYSIS OF VARIANCE...	8,[illegible]			
STANDARD ERROR OF ESTIMATE.........	[illegible]			
(ADJUSTED FOR D.F.)............	[illegible]735			

VARIABLE NUMBER	REGRESSION COEFFICIENT	STD. ERROR OF REG. COEFF.	COMPUTED T-VALUE	
9	-[illegible]1[illegible]E+[illegible]	0,[illegible]3761	-3,[illegible]2	USE F=1
1[illegible]	[illegible]E-01	0,[illegible]2995	1,444	MAIN TKRS
13	-[illegible]E-01	0,[illegible]1337	-3,[illegible]	F[illegible]
5	-[illegible]E-03	0,[illegible]4026	-1,[illegible]9	T[illegible]
17	[illegible]E-01	0,[illegible]1529	4,233	LATES
4	-[illegible]E-01	0,[illegible]52[illegible]	-3,[illegible]44	L[illegible] #82
15	-[illegible]1731E-01	0,[illegible]2917	-2,123	[illegible]
19	[illegible]E+[illegible]	0,11824	1,[illegible]	1
INTERCEPT	[illegible]261			

TOLERANCE = .[illegible]E+[illegible]

TABLE D-9. MIGRATION -- FLASHING LIGHTS -- VOLUME

STEP 3

VARIABLE ENTERED...... 1

SUM OF SQUARES REDUCED IN THIS STEP.... 305.00261
PROPORTION REDUCED IN THIS STEP........ 0.04983

CUMULATIVE SUM OF SQUARES REDUCED...... 3632.59143
CUMULATIVE PROPORTION REDUCED.......... 0.59347 OF 6120.92509

FOR 3 VARIABLES ENTERED
MULTIPLE CORRELATION COEFFICIENT... 0.77037
(ADJUSTED FOR D.F.)............ 0.77033
F-VALUE FOR ANALYSIS OF VARIANCE... 7090.970
STANDARD ERROR OF ESTIMATE......... 0.413
(ADJUSTED FOR D.F.)............ 0.41326

VARIABLE NUMBER	REGRESSION COEFFICIENT	STD. ERROR OF REG. COEFF.	COMPUTED T-VALUE	
3	-0.28280E+01	0.03395	-83.293	1
2	0.82839E-01	0.00190	43.517	LOG C **2
1	0.75130E+00	0.01778	42.253	LOG T
INTERCEPT	0.00043			

TOLERANCE = .30500E+03

TABLE D-9 (cont.)

STEP 3

VARIABLE ENTERED...... 1

SUM OF SQUARES REDUCED IN THIS STEP.... 305.09638
PROPORTION REDUCED IN THIS STEP........ 0.04998

CUMULATIVE SUM OF SQUARES REDUCED...... 3620.20273
CUMULATIVE PROPORTION REDUCED.......... 0.59301 OF 6104.8037

FOR 3 VARIABLES ENTERED
MULTIPLE CORRELATION COEFFICIENT... 0.77007
(ADJUSTED FOR D.F.)............ 0.77003

F-VALUE FOR ANALYSIS OF VARIANCE... 7077.407
STANDARD ERROR OF ESTIMATE......... 0.413
(ADJUSTED FOR D.F.)............ 0.41295

VARIABLE NUMBER	REGRESSION COEFFICIENT	STD. ERROR OF REG. COEFF.	COMPUTED T-VALUE	
3	-0.28335E+01	0.03403	-83.269	1
2	0.83061E-01	0.00191	43.566	LOG C **2
1	0.75300E+00	0.01780	42.301	LOG T
INTERCEPT	0.00040			

TOLERANCE = .30510E+03

STEP 3

VARIABLE ENTERED...... 1

SUM OF SQUARES REDUCED IN THIS STEP.... 305.16557
PROPORTION REDUCED IN THIS STEP........ 0.05907

CUMULATIVE SUM OF SQUARES REDUCED...... 3612.50900
CUMULATIVE PROPORTION REDUCED.......... 0.59271 OF [illegible]

FOR 3 VARIABLES ENTERED
MULTIPLE CORRELATION COEFFICIENT... 0.76988
(ADJUSTED FOR D.F.)............ 0.76984

F-VALUE FOR ANALYSIS OF VARIANCE... 70[illegible].771
STANDARD ERROR OF ESTIMATE......... 0.413
(ADJUSTED FOR D.F.)............ 0.41276

VARIABLE NUMBER	REGRESSION COEFFICIENT	STD. ERROR OF REG. COEFF.	COMPUTED T-VALUE	
3	-0.2[illegible]72E+01	0.03[illegible]	-83.253	1
2	0.8[illegible]E-01	0.001[illegible]1	43.597	LOG C [illegible]
1	0.75[illegible]07E+00	0.01782	42.325	LOG T
INTERCEPT	0.00039			

TOLERANCE = .30317E+03

TABLE D-9 (cont.)

STEP 3

VARIABLE ENTERED...... 1

SUM OF SQUARES REDUCED IN THIS STEP.... 305.18782
PROPORTION REDUCED IN THIS STEP........ 0.05013

CUMULATIVE SUM OF SQUARES REDUCED...... 3607.35922
CUMULATIVE PROPORTION REDUCED.......... 0.59251 OF 6088.0264

FOR 3 VARIABLES ENTERED
MULTIPLE CORRELATION COEFFICIENT... 0.76976
(ADJUSTED FOR D.F.)............ 0.76972
F-VALUE FOR ANALYSIS OF VARIANCE... 7063.339
STANDARD ERROR OF ESTIMATE......... 0.413
(ADJUSTED FOR D.F.)............ 0.41263

VARIABLE NUMBER	REGRESSION COEFFICIENT	STD. ERROR OF REG. COEFF.	COMPUTED T-VALUE	
3	-0.28395E+01	0.03411	-83.245	1
2	0.83292E-01	0.00191	43.616	LOG C **2
1	0.75477E+00	0.01783	42.340	LOG T
INTERCEPT	0.00038			

TOLERANCE = .30519E+03

TABLE D-10. MIGRATION -- FLASHING LIGHTS -- COMPREHENSIVE

STEP 7

VARIABLE ENTERED...... 4

SUM OF SQUARES REDUCED IN THIS STEP.... 2.77453
PROPORTION REDUCED IN THIS STEP........ 0.00045

CUMULATIVE SUM OF SQUARES REDUCED...... 3628.91696
CUMULATIVE PROPORTION REDUCED.......... 0.59029 OF 6147.647

FOR 7 VARIABLES ENTERED
MULTIPLE CORRELATION COEFFICIENT... 0.76831
(ADJUSTED FOR D.F.)............ 0.76820
F-VALUE FOR ANALYSIS OF VARIANCE... 2998.453
STANDARD ERROR OF ESTIMATE......... 0.416
(ADJUSTED FOR D.F.)............ 0.41589

VARIABLE NUMBER	REGRESSION COEFFICIENT	STD. ERROR OF REG. COEFF.	COMPUTED T-VALUE	
1	0.10197E+01	0.02098	48.603	FLGV19.[illegible]
2	0.13305E+00	0.01520	8.756	MAIN [illegible]
5	-0.[illegible]631E-01	0.01469	-6.444	LOG T[illegible]
6	0.16536E-01	0.00589	2.806	LANES
3	-0.36433E-01	0.00675	-5.394	FC
7	0.11623E+00	0.02614	4.446	LOG DT
4	0.18265E-01	0.00456	4.006	POP
INTERCEPT	0.00061			

TOLERANCE = .27745E+01

TABLE D-10 (cont.)

STEP 7

VARIABLE ENTERED..... 4

SUM OF SQUARES REDUCED IN THIS STEP.... 2.80684
PROPORTION REDUCED IN THIS STEP......... 0.00046

CUMULATIVE SUM OF SQUARES REDUCED...... 3566.24307
CUMULATIVE PROPORTION REDUCED.......... 0.58810 OF 6064.050

FOR 7 VARIABLES ENTERED
MULTIPLE CORRELATION COEFFICIENT... 0.76687
(ADJUSTED FOR D.F.)............ 0.76676
F-VALUE FOR ANALYSIS OF VARIANCE... 2971.351
STANDARD ERROR OF ESTIMATE.......... 0.414
(ADJUSTED FOR D.F.)............ 0.41416

VARIABLE NUMBER	REGRESSION COEFFICIENT	STD. ERROR OF REG. COEFF.	COMPUTED T-VALUE	
1	0.10305E+01	0.02112	48.782	FLGV19.DAT
2	0.13531E+00	0.01523	8.887	PAIN TRES
5	-0.96007E-01	0.01472	-6.524	LOG TR*2
6	0.17313E-01	0.00590	2.934	LANES
3	-0.36450E-01	0.00679	-5.370	FC
7	0.11870E+00	0.02622	4.528	LOG DT
4	0.18552E-01	0.00459	4.046	POP
INTERCEPT	0.00053			

TOLERANCE = .28068E+01

TABLE D-10 (cont.)

STEP 7

VARIABLE ENTERED...... 4

SUM OF SQUARES REDUCED IN THIS STEP.... 2.84340
PROPORTION REDUCED IN THIS STEP........ 0.00047

CUMULATIVE SUM OF SQUARES REDUCED...... 3526.48691
CUMULATIVE PROPORTION REDUCED.......... 0.58665 OF 6011.264

FOR 7 VARIABLES ENTERED
MULTIPLE CORRELATION COEFFICIENT... 0.76593
(ADJUSTED FOR D.F.)............ 0.76582
F-VALUE FOR ANALYSIS OF VARIANCE... 2953.634
STANDARD ERROR OF ESTIMATE......... 0.413
(ADJUSTED FOR D.F.)........... 0.41308

VARIABLE NUMBER	REGRESSION COEFFICIENT	STD. ERROR OF REG. COEFF.	COMPUTED T-VALUE	
1	0.10376E+01	0.02122	48.901	FLGV19.DAT
2	0.13601E+00	0.01524	8.961	MAIN TPSS
5	-0.96966E-01	0.01473	-6.580	LOG T**2
6	0.17777E-01	0.00590	3.011	LANES
3	-0.36364E-01	0.00681	-5.341	FC
7	0.12034E+00	0.02626	4.583	LOG OF
4	0.18788E-01	0.00460	4.083	POP
INTERCEPT	0.06046			

TOLERANCE = .28434E+01

STEP 7

VARIABLE ENTERED..... 4

SUM OF SQUARES REDUCED IN THIS STEP.... 2.86852
PROPORTION REDUCED IN THIS STEP........ 0.00048

CUMULATIVE SUM OF SQUARES REDUCED...... 3501.38068
CUMULATIVE PROPORTION REDUCED.......... 0.58570 OF 5978.068

FOR 7 VARIABLES ENTERED
MULTIPLE CORRELATION COEFFICIENT... 0.76531
(ADJUSTED FOR D.F.)........... 0.76520
F-VALUE FOR ANALYSIS OF VARIANCE... 2942.185
STANDARD ERROR OF ESTIMATE......... 0.412
(ADJUSTED FOR D.F.)........... 0.41241

VARIABLE NUMBER	REGRESSION COEFFICIENT	STD. ERROR OF REG. COEFF.	COMPUTED T-VALUE	
1	0.10422E+01	0.02128	48.979	FLGV19.DAT
2	0.13737E+00	0.01526	9.004	MATA TRAS
5	-0.97581E-01	0.01475	-6.618	LOG T-82
6	0.16004E-01	0.00591	3.058	LANES
3	-0.36259E-01	0.00682	-5.315	FC
7	0.12137E+00	0.02629	4.617	LOG D1
4	0.18944E-01	0.00461	4.109	POP
INTERCEPT	0.00042			

TOLERANCE = .28685E+01

TABLE D-11. MIGRATION -- GATES -- VOLUME

STEP 2

VARIABLE ENTERED..... 1

SUM OF SQUARES REDUCED IN THIS STEP.... 74.79257
PROPORTION REDUCED IN THIS STEP........ 0.04221

CUMULATIVE SUM OF SQUARES REDUCED...... 1110.82744
CUMULATIVE PROPORTION REDUCED.......... 0.62684 OF 1772.1185

FOR 2 VARIABLES ENTERED
MULTIPLE CORRELATION COEFFICIENT... 0.79173
(ADJUSTED FOR D.F.)........... 0.79167
F-VALUE FOR ANALYSIS OF VARIANCE... 3262.982
STANDARD ERROR OF ESTIMATE......... 0.413
(ADJUSTED FOR D.F.)........... 0.41263

VARIABLE NUMBER	REGRESSION COEFFICIENT	STD. ERROR OF REG. COEFF.	COMPUTED T-VALUE	
2	-0.19453E+01	0.04518	-43.056	1
1	0.18296E+00	0.00873	20.962	LOG T * LOG C
INTERCEPT	-0.00072			

TOLERANCE = .74793E+02

STEP 2

VARIABLE ENTERED..... 1

SUM OF SQUARES REDUCED IN THIS STEP.... 75.14251
PROPORTION REDUCED IN THIS STEP........ 0.04274

CUMULATIVE SUM OF SQUARES REDUCED...... 1100.23176
CUMULATIVE PROPORTION REDUCED.......... 0.62585 OF 1758.0597

FOR 2 VARIABLES ENTERED
MULTIPLE CORRELATION COEFFICIENT... 0.79111
(ADJUSTED FOR D.F.)........... 0.79105
F-VALUE FOR ANALYSIS OF VARIANCE... 3249.313
STANDARD ERROR OF ESTIMATE......... 0.411
(ADJUSTED FOR D.F.)........... 0.41153

VARIABLE NUMBER	REGRESSION COEFFICIENT	STD. ERROR OF REG. COEFF.	COMPUTED T-VALUE	
2	-0.19567E+01	0.04548	-43.023	1
1	0.18464E+00	0.00876	21.067	LOG T * LOG C
INTERCEPT	-0.00077			

TOLERANCE = .75143E+02

TABLE D-11 (cont.)

STEP 2

VARIABLE ENTERED..... 1

SUM OF SQUARES REDUCED IN THIS STEP.... 75.35812
PROPORTION REDUCED IN THIS STEP........ 0.04306

CUMULATIVE SUM OF SQUARES REDUCED...... 1094.18811
CUMULATIVE PROPORTION REDUCED.......... 0.62527 OF 1749.[illegible]

FOR 2 VARIABLES ENTERED
MULTIPLE CORRELATION COEFFICIENT... 0.79074
(ADJUSTED FOR D.F.)............ 0.79[illegible]
F-VALUE FOR ANALYSIS OF VARIANCE... 3241.196
STANDARD ERROR OF ESTIMATE......... 0.411
(ADJUSTED FOR D.F.)........... 0.4109[illegible]

VARIABLE NUMBER	REGRESSION COEFFICIENT	STD. ERROR OF REG. COEFF.	COMPUTED T-VALUE	
2	-0.19634E+01	0.04566	-43.0[illegible]2	1
1	0.18563E+0[illegible]	0.00879	21.129	LOG T * LOG C
INTERCEPT	-0.00080			

TOLERANCE = .75358E+02

STEP 2

VARIABLE ENTERED..... 1

SUM OF SQUARES REDUCED IN THIS STEP.... 75.48342
PROPORTION REDUCED IN THIS STEP........ 0.04325

CUMULATIVE SUM OF SQUARES REDUCED...... 1090.63530
CUMULATIVE PROPORTION REDUCED.......... 0.62492 OF 1745.[illegible]

FOR 2 VARIABLES ENTERED
MULTIPLE CORRELATION COEFFICIENT... 0.79052
(ADJUSTED FOR D.F.)............ 0.79046
F-VALUE FOR ANALYSIS OF VARIANCE... 3236.407
STANDARD ERROR OF ESTIMATE......... 0.410
(ADJUSTED FOR D.F.)........... 0.41[illegible]53

VARIABLE NUMBER	REGRESSION COEFFICIENT	STD. ERROR OF REG. COEFF.	COMPUTED T-VALUE	
2	-0.19674E+01	0.04576	-42.99[illegible]	1
1	0.18621E+0[illegible]	0.0088[illegible]	21.166	LOG T * LOG C
INTERCEPT	-0.00081			

TOLERANCE = .75483E+02

TABLE D-12. MIGRATION -- GATES -- COMPREHENSIVE

STEP 4

VARIABLE ENTERED...... 2

SUM OF SQUARES REDUCED IN THIS STEP.... 9.30615
PROPORTION REDUCED IN THIS STEP........ 0.00535

CUMULATIVE SUM OF SQUARES REDUCED...... 1751.47261
CUMULATIVE PROPORTION REDUCED.......... 0.62149 OF 17[illegible].[illegible]94

FOR 4 VARIABLES ENTERED
MULTIPLE CORRELATION COEFFICIENT... 0.78835
(ADJUSTED FOR D.F.)............ 0.78815
F-VALUE FOR ANALYSIS OF VARIANCE... 15[illegible].91[illegible]
STANDARD ERROR OF ESTIMATE......... 0.412
(ADJUSTED FOR D.F.)............ 0.41232

VARIABLE NUMBER	REGRESSION COEFFICIENT	STD. ERROR OF REG. COEFF.	COMPUTED T-VALUE	
1	[illegible].7802[illegible]E+00	0.[illegible]5225	14.184	GATES9
3	[illegible].1898[illegible]E+00	0.01958	9.698	TRACKS
4	-[illegible]E+00	0.[illegible]9137	-9.[illegible]	1
2	[illegible].92[illegible]37E-01	0.01248	7.4[illegible]7	LANES
INTERCEPT	-[illegible].[illegible]44			

TOLERANCE = .[illegible]E+01

TABLE D-12 (cont.)

STEP. 4

VARIABLE ENTERED...... 2

SUM OF SQUARES REDUCED IN THIS STEP.... 9.33?54
PROPORTION REDUCED IN THIS STEP......... 0.00543

CUMULATIVE SUM OF SQUARES REDUCED....... 1273.34716
CUMULATIVE PROPORTION REDUCED........... 0.63??9 OF 1729.2753

FOR 4 VARIABLES ENTERED
MULTIPLE CORRELATION COEFFICIENT... 0.79734
(ADJUSTED FOR D.F.)............ 0.79765
F-VALUE FOR ANALYSIS OF VARIANCE... 15?8.51?
STANDARD ERROR OF ESTIMATE........ 0.411
(ADJUSTED FOR D.F.)............ 0.41116

VARIABLE NUMBER	REGRESSION COEFFICIENT	STD. ERROR OF REG. COEFF.	COMPUTED T-VALUE	
1	0.7?34??E+??	0.??219	11.?44	GATES?9
3	?.19??7E+??	0.?1963	?.728	TRACKS
4	-?.??????E+??	0.??151	-7.139	1
2	0.??14?E-01	0.?1249	7.459	LANES
INTERCEPT	-0.??44?			

TOLERANCE = .9???E+?1

TABLE D-12 (cont.)

```
STEP 4

VARIABLE ENTERED...... 2

SUM OF SQUARES REDUCED IN THIS STEP....          9.44939
PROPORTION REDUCED IN THIS STEP........          0.00548

CUMULATIVE SUM OF SQUARES REDUCED......       1268.5149R
CUMULATIVE PROPORTION REDUCED..........          0.62821  OF     1722.5196

FOR  4 VARIABLES ENTERED
   MULTIPLE CORRELATION  COEFFICIENT...     0.78754
         (ADJUSTED FOR  D.F.)...........    0.78735
   F-VALUE FOR ANALYSIS OF VARIANCE... 1589.257
   STANDARD ERROR OF ESTIMATE..........      0.410
         (ADJUSTED FOR D.F.)...........     0.41065

   VARIABLE      REGRESSION          STD. ERROR OF       COMPUTED
    NUMBER       COEFFICIENT          REG. COEFF.        T-VALUE
       1         0.7465 E+00           0.05228            14.281   GATED
       3         0.1911 E+00           0.01961             9.745   TRACKS
       4        -0.3398 E+00           0.07916            -4.132   :
       2         0.4597 E-01           0.01253             7.483   LANES
   INTERCEPT    -0.[illegible]

    TOLERANCE = .994E+01
```

TABLE D-12 (cont.)

STEP 4

VARIABLE ENTERED....... 2

SUM OF SQUARES REDUCED IN THIS STEP.... 9.48120
PROPORTION REDUCED IN THIS STEP......... 0.00552

CUMULATIVE SUM OF SQUARES REDUCED....... 1265.62472
CUMULATIVE PROPORTION REDUCED........... 0.61993 OF 1718.9497

FOR 4 VARIABLES ENTERED
MULTIPLE CORRELATION COEFFICIENT... 0.78735
(ADJUSTED FOR D.F.)............ 0.78717
F-VALUE FOR ANALYSIS OF VARIANCE... 15[illegible]3.347
STANDARD ERROR OF ESTIMATE.......... 2.41[illegible]
(ADJUSTED FOR D.F.)............ 2.41[illegible]34

VARIABLE NUMBER	REGRESSION COEFFICIENT	STD. ERROR OF REG. COEFF.	COMPUTED T-VALUE	
1	2.74[illegible]47E+00	0.[illegible]5233	14.3[illegible]3	GATES[illegible]
3	2.1917[illegible]E+00	0.01962	9.755	TRACKS
4	-[illegible].[illegible]E+00	0.[illegible]9155	-9.123	1
2	3.[illegible]E-01	0.0125[illegible]	7.5[illegible]7	LANES
INTERCEPT	-4.[illegible]351			

TOLERANCE = .998125+01

TABLE D-13. SELECTION REGRESSION -- GATES

STEP-WISE MULTIPLE REGRESSION.....GATES

NUMBER OF OBSERVATIONS [illegible]

NUMBER OF VARIABLES 20

NUMBER OF SELECTIONS 1

CONSTANT TO LIMIT VARIABLES 0,[illegible]

VARIABLE NO.	MEAN	STANDARD DEVIATION	VARIABLE	
1	[illegible],60529	[illegible],35121	LOG I	
2	1,59255	0,69239	LOG C	
3	0,9[illegible]	0,71782	LOG I **2	
4	5,51[illegible]7	5,29[illegible]	LOG C **2	
5	14,3[illegible]	35,315[illegible]	I*C/5000	
6	0,46915	0,294[illegible]	LOG [illegible]	
7	0,44779	0,31509	LOG DAY THRU	
8	0,24521	0,27015	LOG SWITCH	
9	0,11521	0,19103	U=0 R=1	Forced out
10	2[illegible]	12,51760	MAX SPEED	
11	[illegible],46-42	0,15703	HWY PAVED	
12	1,28522	1,01110	POP	
13	2,16668	0,80058	FC	
14	0,28519	0,52094	URBY YING HWY	
15	0,29479	0,25227	RR ADV WARN	
16	4,31561	3,60533	TRUCKS	
17	1,17982	0,67308	LANES	
18	3,73939	2,47190	TRACKS	
19	2,46930	0,14133	1	
20	-2,42110	0,41014	ACC=1 NOACC=-1	

TABLE D-13 (cont.)

STEP 4

VARIABLE ENTERED...... 13

SUM OF SQUARES REDUCED IN THIS STEP.... 1.87937
PROPORTION REDUCED IN THIS STEP........ 0.00286

CUMULATIVE SUM OF SQUARES REDUCED...... 6.61951
CUMULATIVE PROPORTION REDUCED.......... 0.01012 OF 653.87129

FOR 4 VARIABLES ENTERED
MULTIPLE CORRELATION COEFFICIENT... 0.10062
(ADJUSTED FOR D.F.)............ 0.09674
F-VALUE FOR ANALYSIS OF VARIANCE... 9.228
STANDARD ERROR OF ESTIMATE......... [illegible]
(ADJUSTED FOR D.F.)............ [illegible]43343

VARIABLE NUMBER	REGRESSION COEFFICIENT	STD. ERROR OF REG. COEFF.	COMPUTED T-VALUE	
15	[illegible]	[illegible]	[illegible]144	RR ADV WARN
17	[illegible]	0.21457	4.295	LANES
5	[illegible]	0.[illegible]	-4.332	LOG C [illegible]2
13	[illegible]	[illegible]	3.559	TRACKS
INTERCEPT	[illegible]			

TOLERANCE = .1[illegible]

TABLE D-13 (cont.)

Step 6

VARIABLE ENTERED [illegible]

SUM OF SQUARES REDUCED IN THIS STEP....	1,13932
PROPORTION REDUCED IN THIS STEP........	0,93174

CUMULATIVE [illegible]........	13,[illegible]17		
[illegible]..............	0,[illegible]	[illegible]	6[illegible]

FOR [illegible] VARIABLES [illegible]

[illegible]........	[illegible]9
[illegible]........	[illegible]33
F-VALUE FOR ANALYSIS OF [illegible]......	[illegible]
STANDARD ERROR OF [illegible]........	[illegible]
[illegible]........	[illegible]

VARIABLE NUMBER	COEFFICIENT (CALCULATED)	STD. ERROR OF COEFF.	COMPUTED T-VALUE	
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
17	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	1,71[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	2,617	POI
INTERCEPT	[illegible]			

TOLERANCE = [illegible]

```
STEP 8

VARIABLE ENTERED......19

SUM OF SQUARES REDUCED IN THIS STEP....          0,21245
PROPORTION REDUCED IN THIS STEP........          0,00032

CUMULATIVE SUM OF SQUARES REDUCED,.....         11,15425
CUMULATIVE PROPORTION REDUCED,..........         0,01706   OF       653,87129

FOR 8 VARIABLES ENTERED
  MULTIPLE CORRELATION COEFFICIENT...      0,13061
         (ADJUSTED FOR D.F.)..........     0,12363
  F-VALUE FOR ANALYSIS OF VARIANCE...      8,415
  STANDARD ERROR OF ESTIMATE.........      0,427
         (ADJUSTED FOR D.F.)..........     0,42742
```

VARIABLE NUMBER	REGRESSION COEFFICIENT	STD. ERROR OF REG. COEFF.	COMPUTED T-VALUE	
15	-0,57647E-01	0,02891	-2,333	RR ADV WARN
17	0,63681E-01	0,01536	4,150	LANES
4	-2,17726E-01	0,02522	-5,407	LOG C **2
18	0,92254E-01	0,02125	4,287	TRACKS
13	-0,50211E-01	0,01332	-3,769	FC
12	0,26743E-01	0,00930	2,377	POP
5	-0,42295E-03	0,00026	-1,536	T*C/5000
19	0,12433E+00	0,10980	1,132	1
INTERCEPT	0,00361			

```
TOLERANCE = ,212452E+00
```

TABLE D-13 (cont.)

Step 10

VARIABLE ENTERED ...... [illegible]

[illegible] 0.94493

[illegible] .... [illegible]

[illegible] .... [illegible] 0.46893

[illegible] .... [illegible] DF [illegible] .87129

[illegible]

[illegible] 0.13737

[illegible] .... 0.12[illegible]

F-VALUE FOR ANALYSIS OF VARIANCE .... 7.[illegible]

STANDARD ERROR OF ESTIMATE .... [illegible]

[illegible] .... [illegible]

VARIABLE NUMBER	REGRESSION COEFFICIENT	STD. ERROR OF REG. COEFF.	COMPUTED T-VALUE	
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	LANES
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	0.12852	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	LOG [illegible]
[illegible]	[illegible]	0.23732	[illegible]	LOG [illegible]
INTERCEPT	[illegible]			

TOLERANCE = [illegible]

APPENDIX E

EXPECTED ACCIDENT FREQUENCY PLOTS AND EOC PLOTS

Figures E-1 through E-8 give expected accident frequency per year versus percent of all crossings which are more hazardous (for a given hazard index and warning device class). (See Section 4.3.) Figures E-9 through E-11 give the percent of all accidents versus percent of all crossings (for a given hazard index and warning device class). The resulting plots of Figures E-9 through E-11 are EOC curves. (See Section 4.1.)

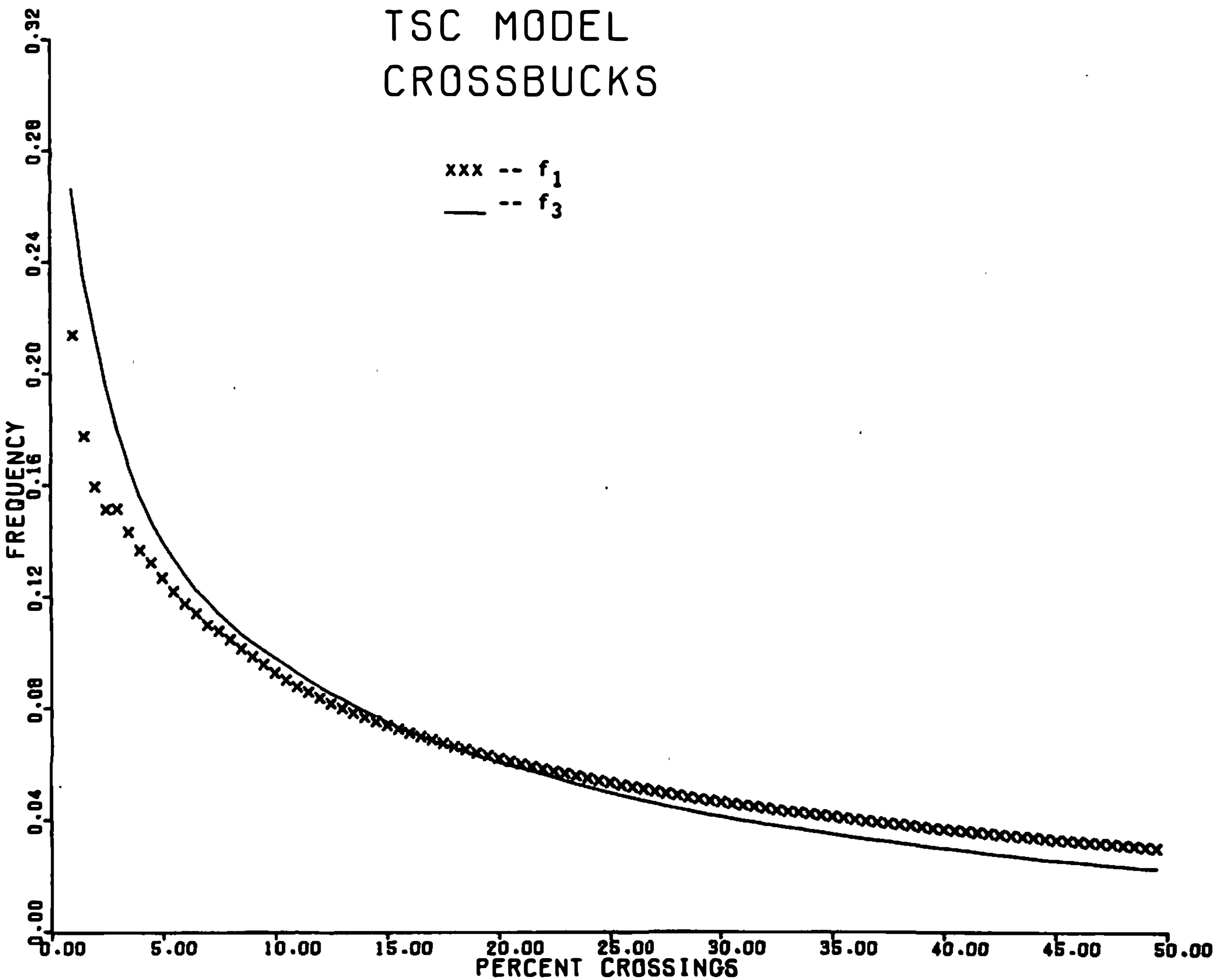


FIGURE E-1. TSC CROSSBUCKS MODEL (f_1 and f_3) (SEE SECTION 4.3)

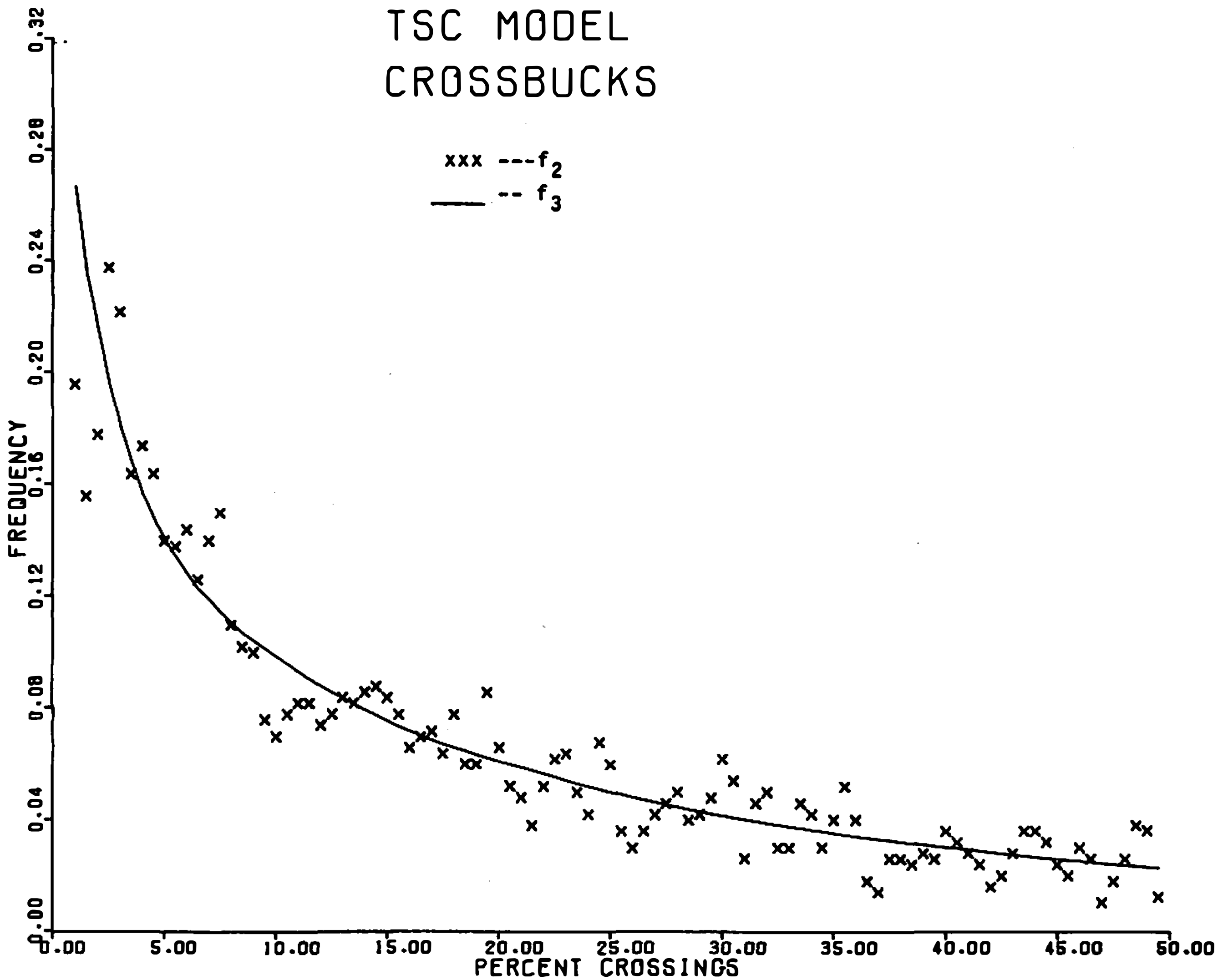


FIGURE E-2. TSC CROSSBUCKS MODEL (f_2 AND f_3) (SEE SECTION 4.3)

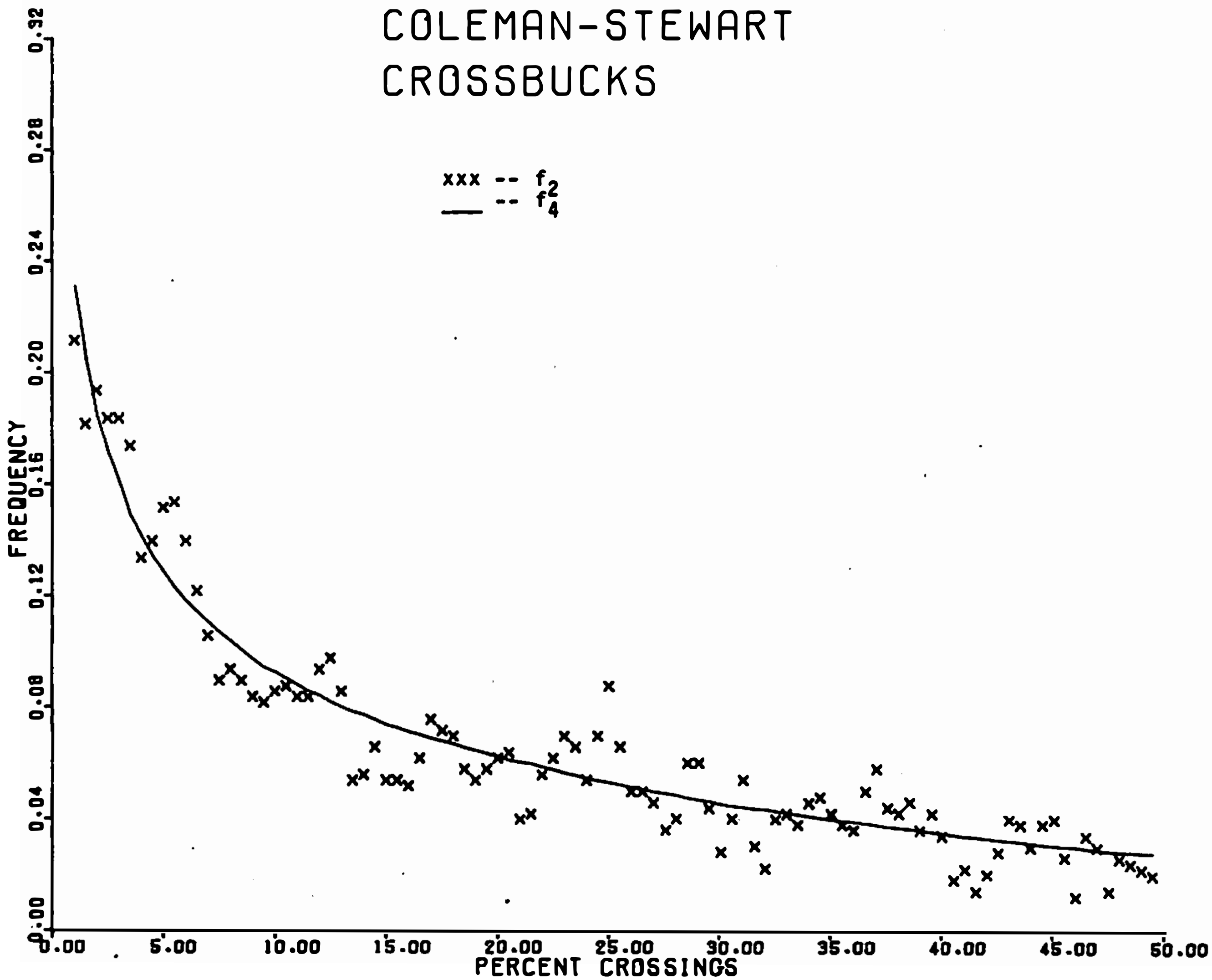


FIGURE E-3. COLEMAN-STEWART CROSSBUCKS MODEL (f_2 AND f_4) (SEE SECTION 4.3)

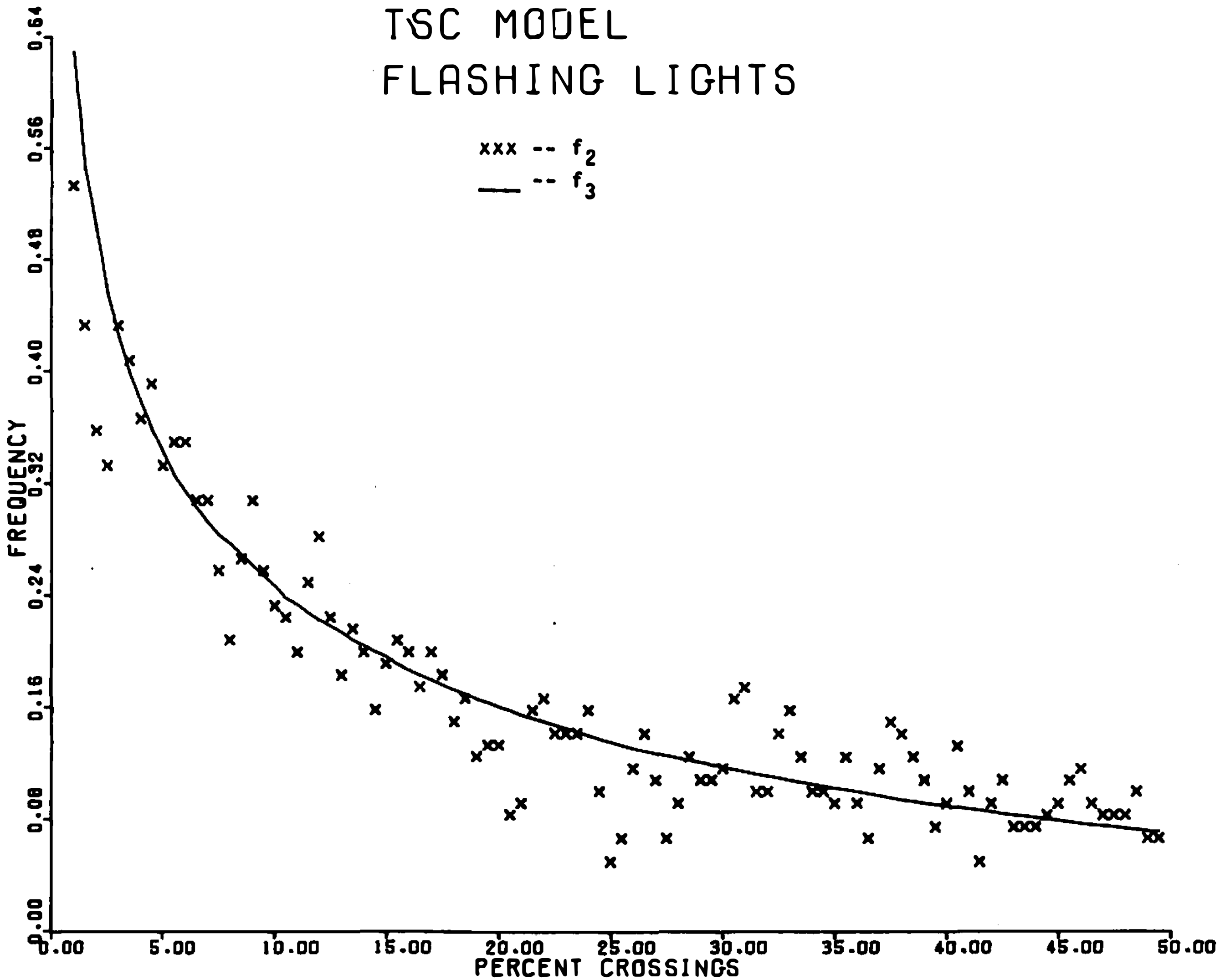


FIGURE E-4. TSC FLASHING LIGHTS MODEL (f_2 AND f_3)

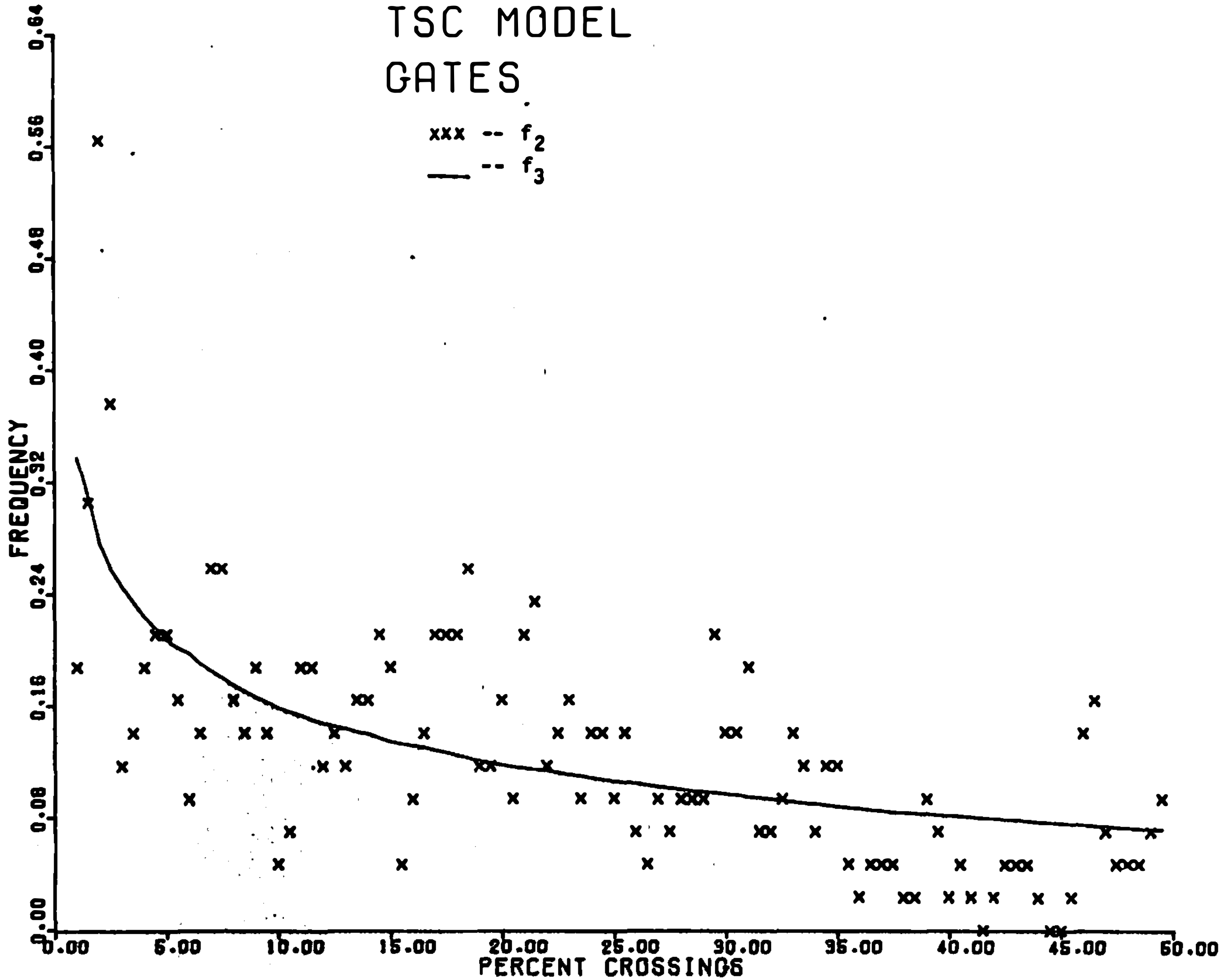


FIGURE E-5. TSC GATES MODEL (f_2 AND f_3)

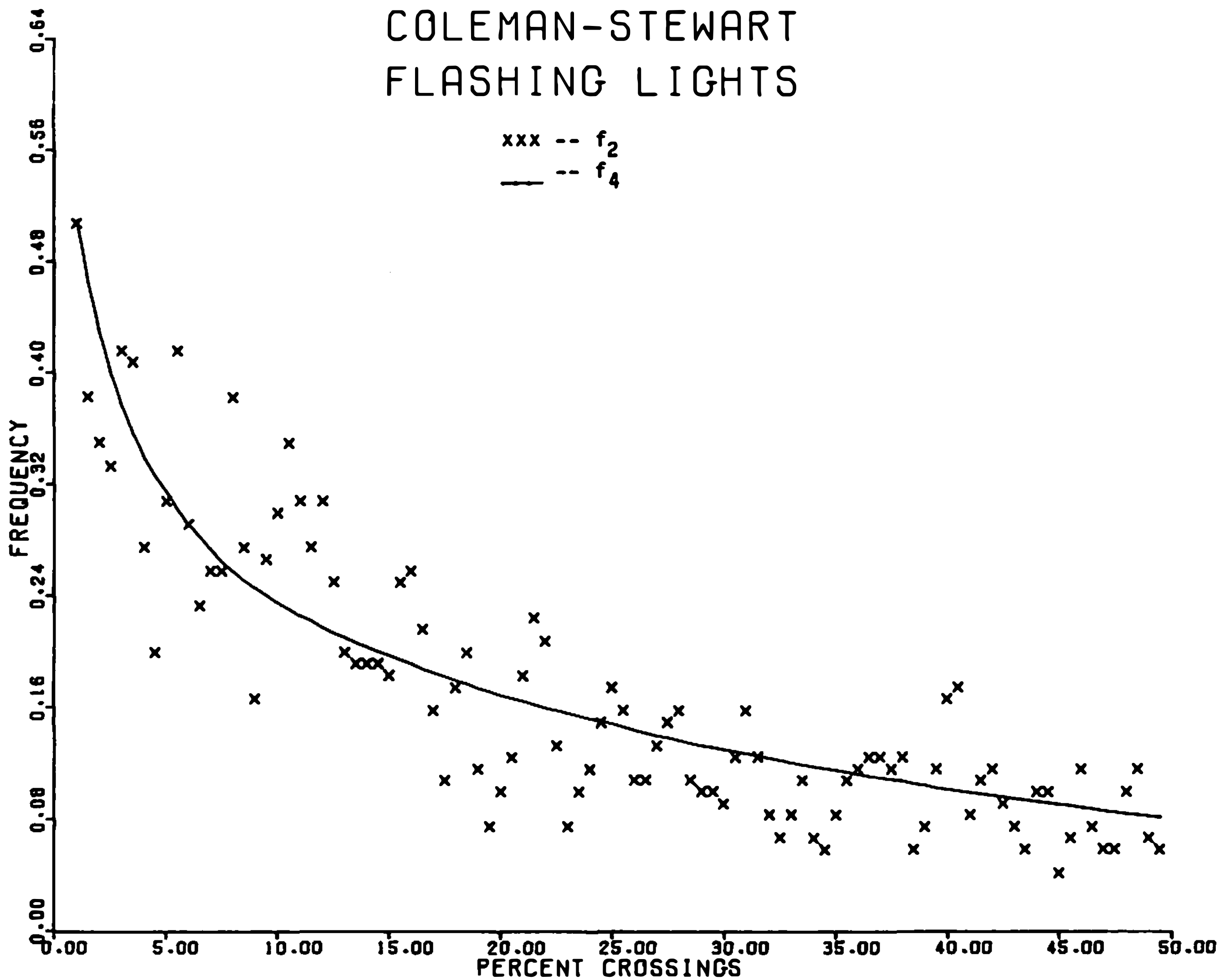


FIGURE E-6. COLEMAN-STEWART FLASHING LIGHTS MODEL (f_2 AND f_4)

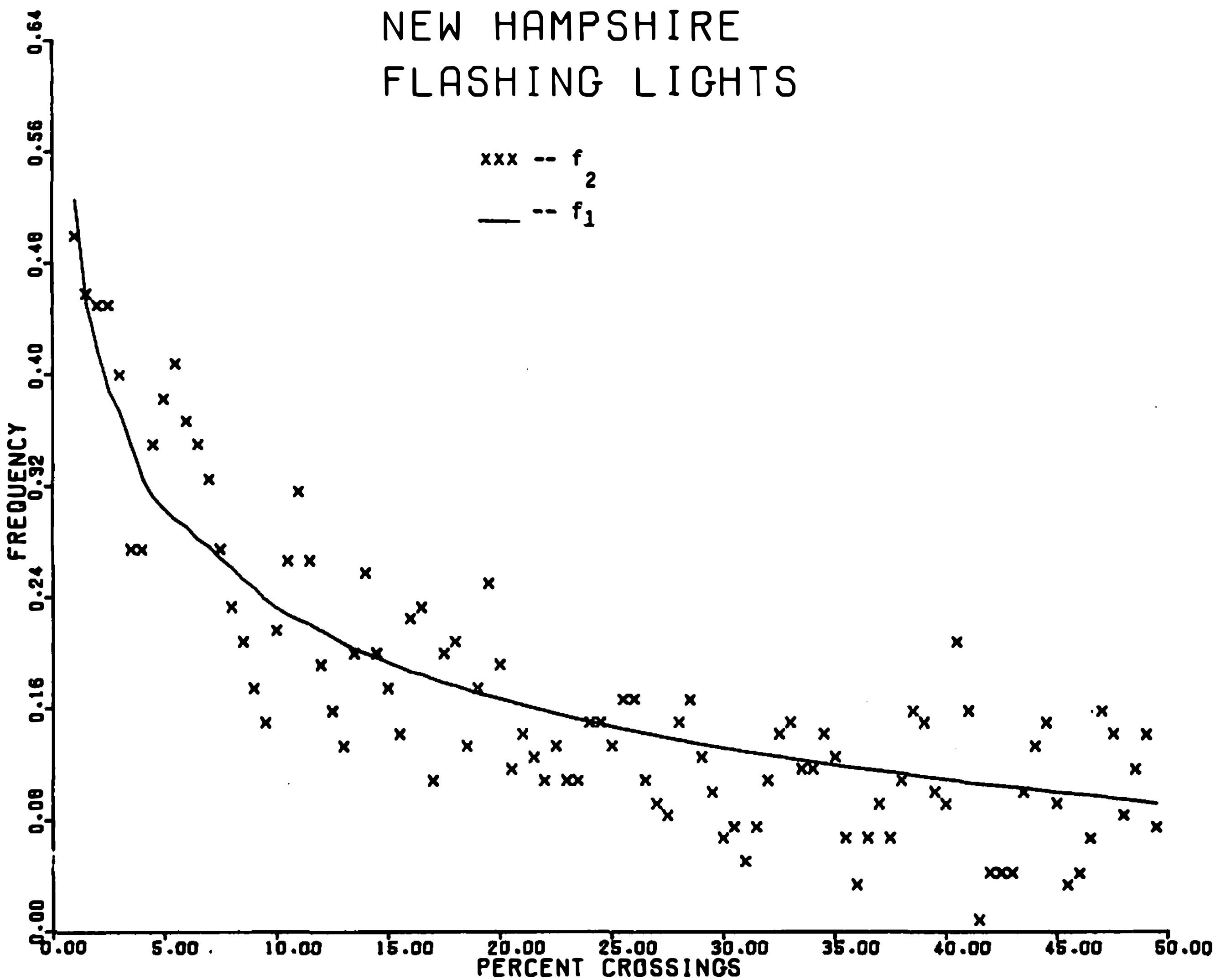


FIGURE E-7. NEW HAMPSHIRE FLASHING LIGHTS MODEL (f_1 AND f_2)

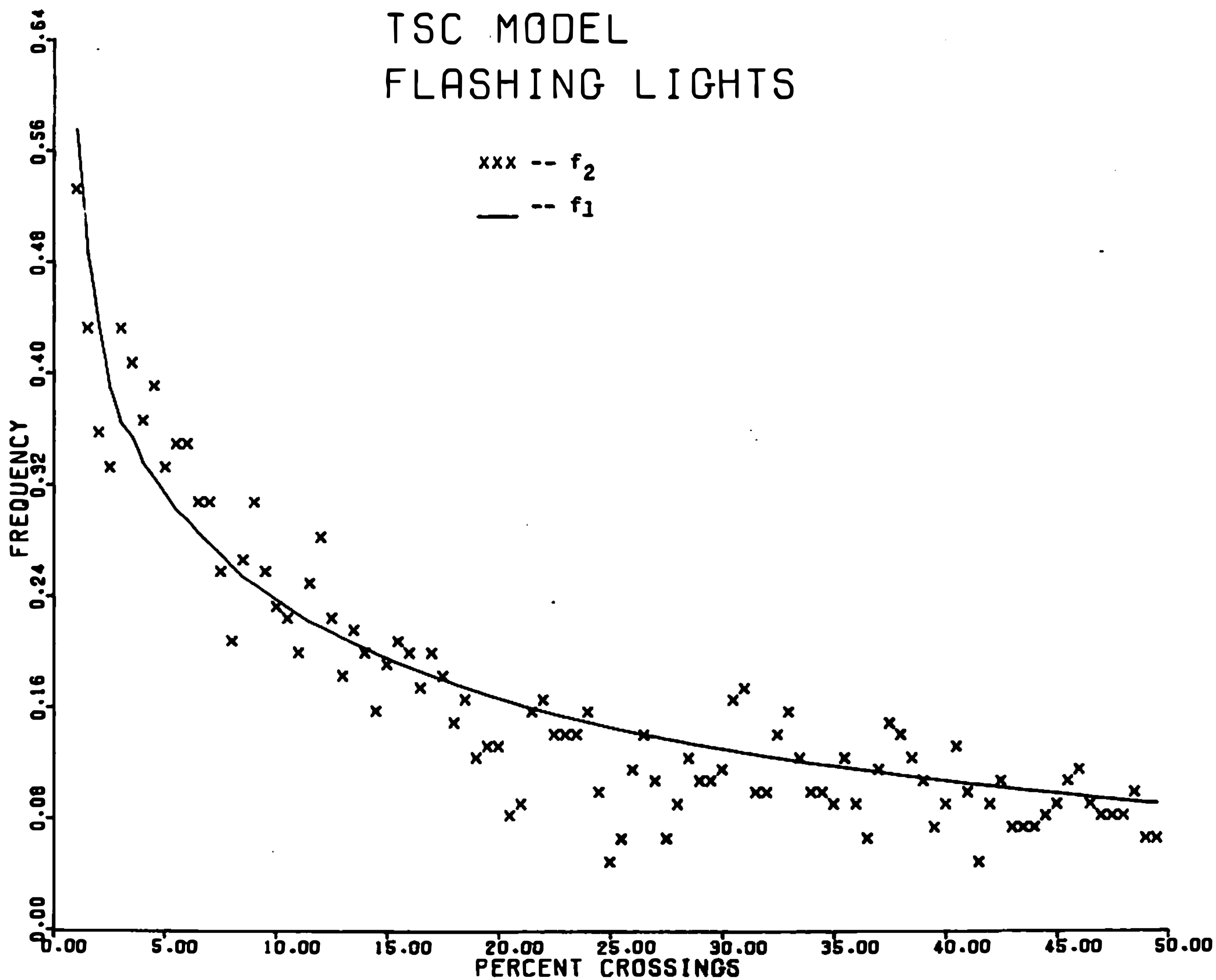


FIGURE E-8. TSC FLASHING LIGHTS MODEL (f_1 AND f_2)

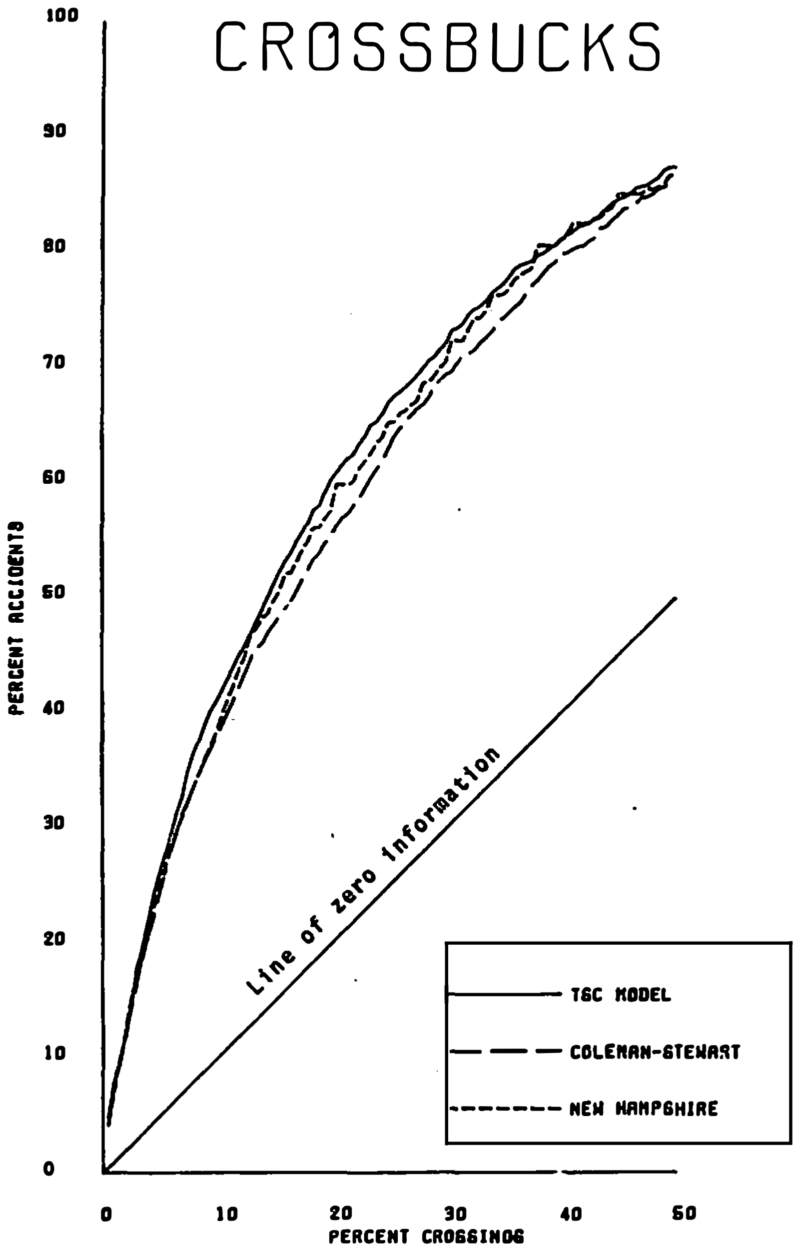


FIGURE E-9. COMPARATIVE EOC'S (CROSSBUCKS)

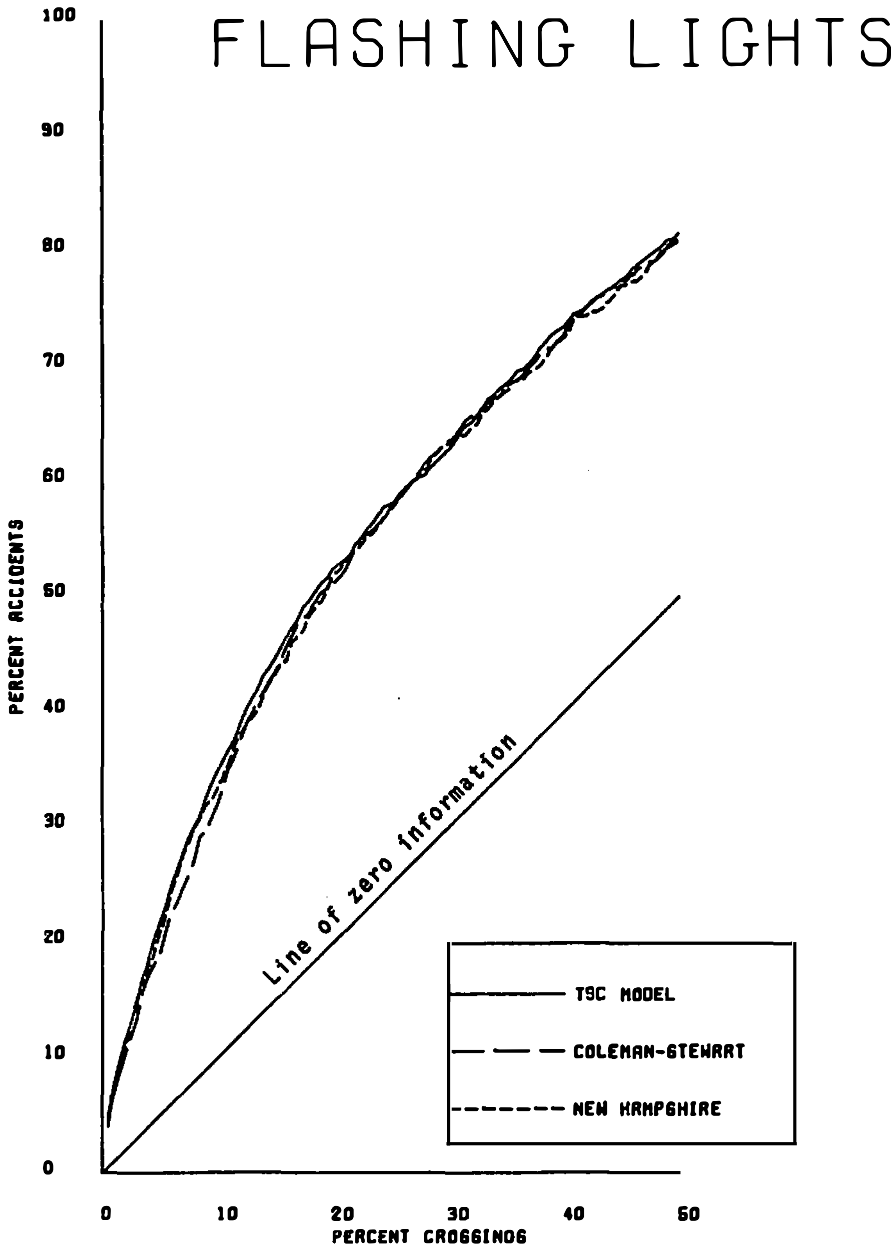


FIGURE E-10. COMPARATIVE EOC'S (FLASHING LIGHTS)

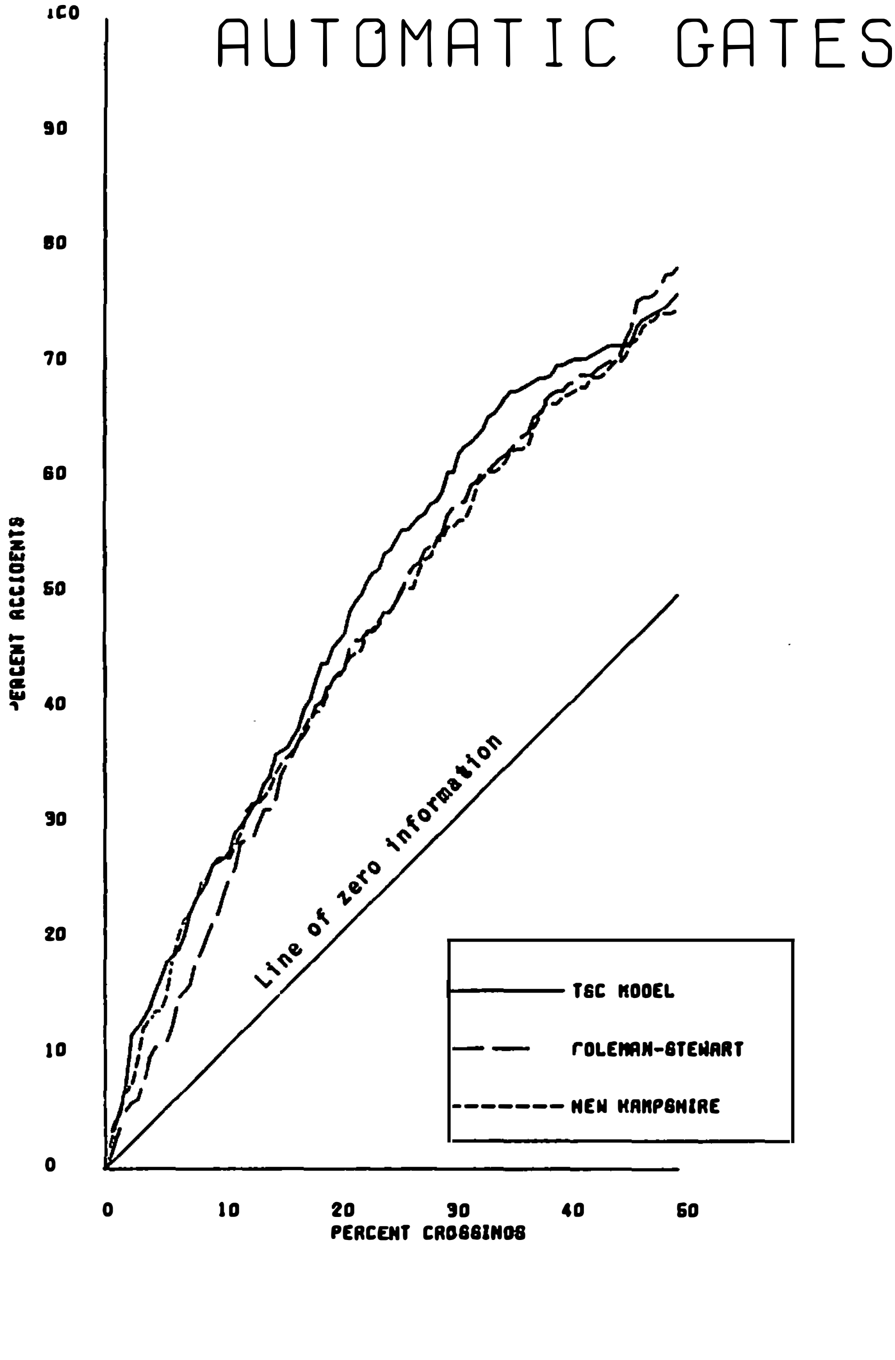


FIGURE E-11. COMPARATIVE EOC'S (AUTOMATIC GATES)

APPENDIX F

DATA BASES

The inventory data used in this study were derived from two sources: a tape containing the inventory characteristics of all public railroad crossings in the U.S., and a tape containing the inventory characteristics of railroad crossings which had an accident in 1975.* Those crossings which had multiple accidents are repeated for every accident they had. Thus, if a crossing had three accidents in 1975, the tape would contain three accounts of its inventory characteristics.

There were 219,162 public railroad crossings in existence in 1975. Included in the accident tape were 8,028 crossings, of which 943 were repetitive. Table F-1 depicts the format for these two tapes. Many of the fields in this table were descriptive in nature and hard to quantify. These fields were extracted from the data base. The resultant data base is shown in Table F-2, while Table F-3 depicts the accident data base and the non-accident data base broken down into warning device class. Table F-4 shows the repetitive nature of the accident data base, while Table F-5 depicts the data sets used in the iterative nonlinear regression.

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*Some of the 1975 accidents did not appear in the data base of the second tape because they could not be linked to crossings. See Subsection 2.3.1.

TABLE F-1. INVENTORY DATA BASE

LOC	LEN	TYPE	DESCRIPTION
1	7	CH	Crossing number (6 digits & check digit)
8	6	CH	Begin date (YYMMDD format)
14	6	CH	End date (YYMMDD format or 999999)
20	1	CH	Crossing status (1-changed, 2-new, 3-closed, 4-change in place)
21	2	ZD	State code
23	1	CH	'C'
24	3	ZD	County code
27	2	ZD	State code
29	4	ZD	City code
33	1	CH	Is city code for city or nearest city? (1-nearest city, 0-city)
34	4	CH	Railroad code
38	14	CH	Railroad division or region
52	14	CH	Railroad subdivision or region
66	7	CH	Highway number
73	17	CH	Street or road name
90	10	CH	Railroad ID number
100	6	ZD	Timetable station
106	15	CH	Branch or line name
121	6	ZD	Milepost (pic 9999V99)
127	10	CH	County map reference number
137	1	CH	Crossing type (1-pedestrian, 2-private, 3-public)
138	1	CH	Crossing position (1-at grade, 2-RR under, 3-rr over)
139	1	CH	Private crossing location (1-farm, 2-residential 3-recreational, 4-industrial)
140	1	CH	Private signs or signals (blank-not a private crossing 1-signs, 2-signals, 3-no signs or signals, 4-both signs and signals)
141	15	CH	Private sign or signal description
156	1	CH	Form initiator (1-railroad, 2-state, 3-DOT, 4-file creation)
157	6	ZD	Batch number

TABLE F-1. INVENTORY DATA BASE (cont.)

LOC	LEN	TYPE	DESCRIPTION
163	1	CH	User code
164	2	CH	Date updated
166	5	ZD	Link Field
Remainder of fields will be blank unless crossing is public at grade.			
171	2	ZD	Number of daylight thru trains
173	2	ZD	Number of daylight switch trains
175	2	ZD	Number of night thru trains
177	2	ZD	Number of night switching trains
179	1	ZD	Less than one train per day? (0-no, 1-yes)
180	3	ZD	Maximum timetable speed
183	3	ZD	Typical minimum speed
186	3	ZD	Typical maximum speed
189	1	ZD	Number of main tracks
190	2	ZD	Number of other tracks
192	10	CH	Description of other tracks
202	1	ZD	Does another railroad operate a separate track at crossing? (1-yes, 2-no)
203	16	CH	List of other railroads with separate track (four characters each)
219	1	ZD	Does another railroad operate over your track at crossing (1-yes, 2-no)
220	16	CH	List of other railroads on same track (4 characters each)
236	1	ZD	Highest warning device class at crossing 8-gates, 7-flashing lights, 6-highway signals, wigwags, or bells, 5-special warning, 1-crossbucks, 3-stop signs, 2-other signal or signals, 1-none of the above)
237	1	ZD	Number of reflectorized crossbucks
238	1	ZD	Number of non-reflectorized crossbucks
239	1	ZD	Number of standard highway stop signs
240	1	ZD	Number of other stop signs
241	1	ZD	Number of other signs (1)
242	10	CH	Description of other signs (1)

TABLE F-1. INVENTORY DATA BASE (cont.)

LOC	LEN	TYPE	DESCRIPTION
252	1	ZD	Number of other signs (2)
253	10	CH	Description of other signs (2)
263	1	ZD	Number of red and white reflectorized gates
264	1	ZD	Number of other colored gates
265	1	ZD	Number of cantilevered flashing lights over traffic lanes
266	1	ZD	Number of cantilevered flashing lights not over traffic lanes
267	1	ZD	Number of mast mounted flashing lights
268	1	ZD	Number of other flashing lights
269	9	CH	Description of other flashing lights
278	.1	ZD	Number of highway traffic signals
279	1	ZD	Number of wigways
280	1	ZD	Number of bells
281	20	CH	Description of special warning not train activated
301	1	ZD	Is track equipped with any signs or signals (1-no, 0-yes)
302	1	ZD	Is commercial power available? (2-no, 1-yes)
303	1	ZD	Method of signalling for train operation: Is track equipped with signals? (2-no, 1-yes)
304	1	ZD	Does crossing provide speed selection (1-yes, 2-no, 3-N/A)
305	1	ZD	Type of development (1-open space, 2-residential, 3-commercial, 4-industrial, 5-institutional)
306	1	ZD	Is highway paved? (2-no, 1-yes) (Note different coding in B.5.1.3)
307	1	ZD	Does track run down a street (2-no, 1-yes)
308	1	ZD	Pavement markings (1-stopline, 2-RR Xing symbol, 3-none, 4-both stoplines and RR Xing symbols)
309	1	ZD	Nearby intersecting highway? (2-no, 1-yes)
310	1	ZD	RR advance warning signs present (2-no, 1-yes)
311	1	ZD	Smallest crossing angle (1-0 to 29 degrees, 2-30 to 59 degrees, 3-60 to 90 degrees)
312	1	ZD	Crossing surface

TABLE F-1. INVENTORY DATA BASE (cont.)

LOC	LEN	TYPE	DESCRIPTION
313	1	ZD	Number of traffic lanes
314	1	ZD	Are truck pullout lanes present? (2-no, 1-yes)
315	1	ZD	Is crossing on state highway system (2-no, 1-yes)
316	2	ZD	Highway system
318	2	ZD	Functional classification of road over crossing (The tens digit codes population.)
320	6	ZD	Estimated AADT
326	2	ZD	Estimated percent trucks

TABLE F-2. EXTRACTED INVENTORY DATA BASE

LOC	LEN	DESCRIPTION
1	7	Crossing number
8	2	State code
10	3	County Code
13	4	Railroad Code
17	7	Highway nubmer
24	2	Number of daylight tru trains
26	2	Number of daylight switch trains
28	2	Number of night thru trains
30	2	Number of night switch trains
32	1	Less than one train per day? (0-no, 1-yes)
33	3	Maximum timetable speed
36	3	Typical minimum speed
39	3	Typical maximum speed
42	1	Number of main tracks
43	2	Number of other tracks
45	1	Does another railroad operate on a separate track at crossing? (1-yes, 2-no)
46	1	Does another railroad operate over your track at crossing (1-yes, 2-no)
47	1	Highest warning device class at crossing (8-gates, 7-flashing lights, 6-highway signals, wigwags, or bells, 5- signal warning, 4-crossbucks, 3-stop signs, 2-other signs or signals, 1-none)
48	1	Number of reflectorized crossbucks
49	1	Number of non-reflectorized crossbucks
50	1	Number of standard highway stop signs
51	1	Number of other stop signs
52	1	Number of other signs (1)
53	1	Number of other signs (2)
54	1	Number of red and white reflectorized gates
55	1	Number of other colored gates
56	1	Number of cantilevered flashing lights over traffic lanes
57	1	Number of cantilevered flashing lights not over traffic lanes

TABLE F-2. EXTRACTED INVENTORY DATA BASE (cont.)

LOC	LEN	DESCRIPTION
58	1	Number of most mounted flashing lights
59	1	Number of other flashing lights
60	1	Number of highway traffic signals
61	1	Number of wigwags
62	1	Number of bells
63	1	Is track equipped with any signs or signal (1-no, 0-yes)
64	1	Method of signalling for train operation: Is track equipped with signals? (2-no, 1-yes)
65	1	Does crossing provide speed selection (1-yes 2-no 3-N/A)
66	1	Type of development (1-open spose, 2-residential 3-commercial, 4-industrial, 5-institutional)
67	1	Is highway paved? (2-no, 1-yes)
68	1	Does track run down a street (2-no, 1-yes)
69	1	Pavement markings (1-stopline, 2-RR crossing symbol 3-none, 4-both stoplines and RR Xing symbol)
70	1	Nearby intersecting highway? (2-no, 1-yes)
71	1	RR advance warning signs present (2-no, 1-yes)
72	1	Smallest crossing angle (1-0 to 29 degrees, 2-30 to 59 degrees, 3-60 to 90 degrees)
73	1	Crossing Surface
74	1	Number of traffic lanes
75	1	Are truck pullout lanes present (2-no, 1-yes)
76	1	Is crossing on state highway system (2-no, 1-yes)
77	2	Highway System
79	2	Functional classification of road over crossing*
81	6	Estimated AADT
87	2	Estimated percent trucks

*The tens digit of LOC 79 codes population. See Reference 4.

TABLE F-3. BREAKDOWN BY WARNING DEVICE CLASS

Warning Device Class	Non-Accident	Accident
Gates	11,983	707
Flashing Lights	33,969	2,650
Highway signals, wigwags, bells	3,395	169
Special warning	8,418	216
Crossbucks	141,477	3,969
Standard highway stop signs	3,525	109
Other signs	1,079	15
None	15,316	193
	219,162	8,028

TABLE F-4. BREAKDOWN BY MULTI-ACCIDENTS

# Accidents	# Crossings	# Repetitions
1	6,344	0
2	609	609
3	96	192
4	21	63
5	9	36
6	0	0
7	2	12
8	2	14
9	1	8
10	1	9
	7,085	943

Total sample size = 8,028

Total number of repetitions = 943

TABLE F-5. COMPOSITION OF DISJOINT DATA BASES USED FOR MODEL CONSTRUCTION AND TESTING

TEST DATA BASE (SUBDATA BASE B OF FIGURE 2-1)

	Gates	Flashing Lights	Wigwags Bells	Special	Cross-bucks	Stop Sign	Other Sign	None	Total
Accident	354	1,324	85	108	1,984	55	8	96	4,014
Non-accident	3,535	13,250	485	1,177	20,188	493	147	2,203	41,478
Total	3,889	14,574	570	1,285	22,172	548	155	2,299	45,492

VALIDATION DATA BASE (SUBDATA BASE A OF FIGURE 2-1)

	Gates	Flashing Lights	Wigwags Bells	Special	Cross-bucks	Stop Sign	Other Sign	None	Total
Accident	353	1,326	84	108	1,985	54	7	97	4,014
Non-accident	3,535	13,250	487	1,178	20,188	493	147	2,204	41,482
Total	3,888	14,576	571	1,286	22,173	547	154	2,301	45,496

APPENDIX G

NONLINEAR (LOGISTIC) VERSUS LINEAR CONSTRUCTION

AN EXPERIMENT TO COMPARE THE LINEAR MODELS WITH THE LOGISTIC MODELS

Considerable time had elapsed (and corresponding experience gained) between the development of the best comprehensive linear models 8-C and 8-D and the corresponding comprehensive logistic models which are reported as the best TSC models in this report. Consequently, it seemed desirable to obtain some comparison of the earlier linear models with the later logistic models. The earlier models had been thought to be good, and had even outperformed the New Hampshire and Coleman-Stewart models. The trouble was that the data base on which they were tested was not disjoint with the data base on which they were constructed (this was inadvertent). It was expected that the later logistic models would perform better than the earlier linear models. This was indeed the case. The surprising feature was how poorly the earlier linear models did perform. This is explained later in the Appendix, but first, a description is given of the experiment for comparing the models.

Since the data bases were reconstructed after it was discovered that they were not disjoint, the new data bases (which are purely disjoint in themselves) partially overlap the old data bases. Thus, to test linear model 8-C it was necessary to retune it on one data base and run its EOCs -- power factors on the disjoint data base. This was done, with the variables in the volume part of 8-C being run through a new linear volume regression so that the same variables appeared but the coefficients were retuned. The full regression was also completed in the same manner. Thus, a model identical with 8-C (crossbucks) in its variables but with its coefficients tuned to the latest construction data base was constructed. The EOC was run against the TSC comprehensive model; the results are shown in Table G-1. (See Appendix C and Section 2 for information on how to read EOCs.)

The test result indicated that the linear models were unsatisfactory. They were not significantly worse than the New Hampshire model, but no better. It seems that linear regression technique is inadequate to produce hazard functions, which are essentially non-linear -- probably an approximate function of a product of car and train variables. Any function can be built up out of linear terms. However, the straight linear approach was evidently not powerful enough for this purpose. As a result, the new models developed of primary interest are those of nonlinear construction which are reported on in Section 4.

TABLE G-1. EOC BEST LINEAR VERSUS BEST NON-LINEAR MODEL (CROSSBUCKS)

% Xing	NON-LINEAR MODEL INC ACC	NON-LINEAR MODEL CUM ACC	NON-LINEAR MODEL % ACC	NON-LINEAR MODEL POWER FACTR	NON-LINEAR MODEL HAZARD INDEX	LINEAR MODEL INC ACC	LINEAR MODEL CUM ACC	LINEAR MODEL % ACC	LINEAR MODEL POWER FACTR	LINEAR MODEL HAZARD INDEX	WITH MATCH %DIFF	WITH MATCH TVAL	INC MTCH	CUM MTCH	NON-LINEAR LESS MATCH ACC	NON-LINEAR LESS MATCH % ACC	LINEAR LESS MATCH ACC	LINEAR LESS MATCH % ACC	LESS MATCH %DIFF	LESS MATCH TVAL
0.50	96	96	4.84	9.68	-1095	80	80	4.03	8.06	3347	0.81	1.2	54	54	42	2.12	26	1.31	0.81	1.9
1.00	60	156	7.86	7.86	-2279	53	133	6.70	6.70	2942	1.16	1.4	36	90	66	3.33	43	2.17	1.16	2.2
1.50	38	194	9.78	6.52	-2896	47	180	9.07	6.05	2677	0.71	0.7	37	127	67	3.38	53	2.67	0.71	1.3
2.00	40	234	11.79	5.90	-3326	65	245	12.35	6.17	2431	-0.55	-0.5	47	174	60	3.02	71	3.58	-0.55	-1.0
2.50	49	283	14.26	5.71	-3880	62	307	15.47	6.19	2298	-1.21	-1.0	49	223	60	3.02	84	4.23	-1.21	-2.0
3.00	70	353	17.79	5.93	-4220	48	355	17.89	5.96	2119	-0.10	-0.1	56	279	74	3.73	76	3.83	-0.10	-0.2
3.50	41	394	19.86	5.67	-4579	27	382	19.25	5.50	2013	0.60	0.4	24	303	91	4.59	79	3.98	0.60	0.9
4.00	41	435	21.93	5.48	-4920	38	420	21.17	5.29	1920	0.76	0.5	39	342	93	4.69	78	3.93	0.76	1.1
4.50	46	481	24.24	5.39	-5212	30	450	22.68	5.04	1846	1.56	1.0	32	374	107	5.39	76	3.83	1.56	2.3
5.00	36	517	26.06	5.21	-5460	39	489	24.65	4.89	1763	1.61	1.0	39	413	104	5.24	72	3.63	1.61	2.4
5.50	34	551	27.77	5.05	-5700	23	512	25.81	4.69	1689	1.97	1.2	27	440	111	5.59	72	3.63	1.97	2.9
6.00	35	586	29.54	4.92	-5928	28	540	27.22	4.54	1630	2.32	1.4	30	470	116	5.85	70	3.53	2.32	3.4
6.50	37	623	31.40	4.83	-6152	31	571	28.78	4.43	1574	2.62	1.5	37	507	116	5.85	64	3.23	2.62	3.9
7.00	26	649	32.71	4.67	-6312	30	601	30.29	4.33	1519	2.42	1.4	19	526	123	6.20	75	3.78	2.42	3.4
7.50	44	693	34.93	4.66	-6500	22	623	31.40	4.19	1471	3.53	1.9	31	557	136	6.85	66	3.33	3.53	4.9
8.00	31	724	36.49	4.56	-6670	20	643	32.41	4.05	1425	4.08	2.2	25	582	142	7.16	61	3.07	4.08	5.7
8.50	24	748	37.70	4.44	-6840	20	663	33.42	3.93	1381	4.28	2.3	21	603	145	7.31	60	3.02	4.28	5.9
9.00	27	775	39.06	4.34	-6985	26	689	34.73	3.86	1343	4.33	2.2	27	630	145	7.31	59	2.97	4.33	6.0
9.50	23	798	40.22	4.23	-7117	28	717	36.14	3.80	1304	4.08	2.1	29	659	139	7.01	58	2.92	4.08	5.8
10.00	15	813	40.98	4.10	-7298	20	737	37.15	3.71	1273	3.83	1.9	21	680	133	6.70	57	2.87	3.83	5.5
10.50	20	833	41.99	4.00	-7391	29	766	38.61	3.65	1236	3.38	1.7	21	701	132	6.65	65	3.28	3.38	4.8
11.00	19	852	42.94	3.90	-7540	23	789	39.77	3.62	1199	3.18	1.6	25	726	126	6.35	63	3.18	3.18	4.6
11.50	22	874	44.05	3.83	-7681	25	814	41.03	3.57	1165	3.02	1.5	23	749	125	6.30	65	3.28	3.02	4.4
12.00	19	893	45.01	3.75	-7820	15	829	41.78	3.48	1138	3.23	1.5	20	769	124	6.25	60	3.02	3.23	4.7
12.50	18	911	45.92	3.67	-7956	23	852	42.94	3.44	1106	2.97	1.4	17	786	125	6.30	66	3.33	2.97	4.3
13.00	21	932	46.98	3.61	-8060	21	873	44.00	3.38	1077	2.97	1.4	18	804	128	6.45	69	3.48	2.97	4.2
13.50	21	953	48.03	3.56	-8209	15	888	44.76	3.32	1053	3.28	1.6	18	822	131	6.60	66	3.33	3.28	4.6
14.00	20	973	49.04	3.50	-8339	26	914	46.07	3.29	1022	2.97	1.4	20	842	131	6.60	72	3.63	2.97	4.1
14.50	23	996	50.20	3.46	-8498	22	936	47.18	3.25	995	3.02	1.4	20	862	134	6.75	74	3.73	3.02	4.2
15.00	21	1017	51.26	3.42	-8585	22	958	48.29	3.28	966	2.97	1.3	15	877	140	7.06	81	4.08	2.97	4.0
15.50	21	1038	52.32	3.38	-8724	18	976	49.19	3.17	946	3.13	1.4	19	896	142	7.16	80	4.03	3.12	4.2
16.00	18	1056	53.23	3.33	-8827	21	997	50.25	3.14	924	2.97	1.3	23	919	137	6.91	78	3.93	2.97	4.0
16.50	15	1071	53.98	3.27	-8937	21	1018	51.31	3.11	901	2.67	1.8	19	938	133	6.70	80	4.03	2.67	3.8
17.00	20	1091	54.99	3.23	-9055	25	1043	52.57	3.09	877	2.42	1.0	24	962	129	6.50	81	4.08	2.42	3.3
17.50	16	1107	55.80	3.19	-9194	22	1065	53.68	3.07	855	2.12	0.9	21	983	124	6.25	82	4.13	2.12	2.9
18.00	16	1123	56.60	3.14	-9296	16	1081	54.49	3.03	835	2.12	0.9	12	995	128	6.45	86	4.33	2.12	2.9
18.50	23	1146	57.76	3.12	-9345	12	1093	55.09	2.98	813	2.67	1.1	21	1016	130	6.55	77	3.88	2.67	3.7
19.00	7	1153	58.11	3.06	-9493	18	1111	56.00	2.95	795	2.12	0.9	14	1030	123	6.20	81	4.08	2.12	2.9
19.50	23	1176	59.27	3.04	-9548	15	1126	56.75	2.91	774	2.52	1.0	20	1050	126	6.35	76	3.83	2.52	3.5
20.00	20	1196	60.28	3.01	-9650	18	1144	57.66	2.88	753	2.62	1.1	21	1071	125	6.30	73	3.68	2.62	3.7
20.50	13	1209	60.94	2.97	-9735	18	1162	58.57	2.86	734	2.37	1.0	15	1086	123	6.20	76	3.83	2.37	3.3
21.00	13	1222	61.59	2.93	-9817	12	1174	59.17	2.82	716	2.42	1.0	16	1102	120	6.05	72	3.63	2.42	3.5
21.50	11	1233	62.15	2.89	-9916	15	1189	59.93	2.78	699	2.42	1.0	17	1119	114	5.75	70	3.53	2.42	3.5
22.00	8	1241	62.55	2.84	-10021	15	1200	60.48	2.75	682	2.07	0.8	11	1126	115	5.80	74	3.73	2.07	3.0
22.50	18	1259	63.46	2.82	-10120	8	1208	60.89	2.71	667	2.57	1.0	12	1138	121	6.10	70	3.53	2.57	3.7
23.00	13	1272	64.11	2.79	-10242	11	1219	61.44	2.67	653	2.67	1.1	14	1152	120	6.05	67	3.38	2.67	3.9
23.50	19	1291	65.07	2.77	-10398	10	1229	61.95	2.64	635	3.13	1.2	11	1163	128	6.45	66	3.33	3.13	4.5
24.00	6	1297	65.37	2.72	-10443	13	1242	62.60	2.61	619	2.77	1.1	17	1180	117	5.90	62	3.13	2.77	4.1
24.50	15	1312	66.13	2.70	-10530	13	1255	63.26	2.58	604	2.87	1.1	14	1194	118	5.95	61	3.07	2.87	4.3
25.00	19	1331	67.09	2.68	-10641	13	1268	63.91	2.56	906	3.18	1.8	21	1215	116	5.85	53	2.67	3.18	6.0

TABLE G-1. (CONT.)

% Xing	NON-LINEAR MODEL INC ACC	NON-LINEAR MODEL CUM #ACC	NON-LINEAR MODEL % ACC	NON-LINEAR MODEL POWER FACTR	NON-LINEAR MODEL HAZARD INDEX	LINEAR MODEL INC ACC	LINEAR MODEL CUM #ACC	LINEAR MODEL % ACC	LINEAR MODEL POWER FACTR	LINEAR MODEL HAZARD INDEX	WITH MATCH %DIFF	WITH MATCH TVAL	INC MTCH	CUM MTCH	NON-LINEAR LESS MATCH #ACC	NON-LINEAR LESS MATCH % ACC	LINEAR LESS MATCH #ACC	LINEAR LESS MATCH % ACC	LESS MATCH %DIFF	LESS MATCH TVAL
25.50	11	1342	67.64	2.65	-10732	17	1285	64.77	2.54	570	2.87	1.1	12	1227	115	5.80	58	2.92	2.87	4.3
26.00	7	1349	67.99	2.62	-10828	10	1295	65.27	2.51	555	2.72	1.1	8	1235	114	5.75	60	3.02	2.72	4.1
26.50	8	1357	68.40	2.58	-10927	7	1302	65.63	2.48	539	2.77	1.1	6	1241	116	5.85	61	3.07	2.77	4.1
27.00	10	1367	68.90	2.55	-11014	9	1311	66.08	2.45	524	2.82	1.1	12	1253	114	5.75	58	2.92	2.82	4.3
27.50	11	1378	69.46	2.53	-11115	14	1325	66.78	2.43	509	2.67	1.0	13	1266	112	5.65	59	2.97	2.67	4.1
28.00	12	1390	70.06	2.50	-11209	19	1344	67.74	2.40	493	2.32	0.9	15	1281	109	5.49	63	3.18	2.32	3.5
28.50	13	1403	70.72	2.46	-11298	14	1358	68.45	2.40	476	2.27	0.9	15	1296	107	5.39	62	3.13	2.27	3.5
29.00	7	1410	71.07	2.45	-11374	11	1369	69.00	2.38	463	2.07	0.8	8	1304	106	5.34	65	3.28	2.07	3.1
29.50	14	1424	71.77	2.43	-11461	8	1377	69.41	2.35	447	2.37	0.9	9	1313	111	5.59	64	3.23	2.37	3.6
30.00	10	1434	72.28	2.41	-11554	10	1387	69.91	2.33	434	2.37	0.9	12	1325	109	5.49	62	3.13	2.37	3.6
30.50	21	1455	73.34	2.40	-11653	10	1397	70.41	2.31	422	2.92	1.1	15	1340	115	5.80	57	2.87	2.92	4.4
31.00	6	1461	73.64	2.38	-11736	13	1410	71.07	2.29	408	2.57	1.0	8	1348	113	5.70	62	3.13	2.57	3.9
31.50	7	1468	73.99	2.35	-11814	10	1420	71.57	2.27	394	2.42	0.9	9	1357	111	5.59	63	3.18	2.42	3.6
32.00	16	1484	74.80	2.34	-11908	10	1430	72.08	2.25	379	2.72	1.0	13	1370	114	5.75	60	3.02	2.72	4.1
32.50	9	1493	75.25	2.32	-11986	10	1440	72.58	2.23	368	2.67	1.0	12	1382	111	5.59	58	2.92	2.67	4.1
33.00	6	1499	75.55	2.29	-12070	13	1453	73.24	2.22	355	2.32	0.8	9	1391	108	5.44	62	3.13	2.32	3.5
33.50	9	1508	76.01	2.27	-12140	16	1469	74.04	2.21	342	1.97	0.7	14	1405	103	5.19	64	3.23	1.97	3.0
34.00	14	1522	76.71	2.26	-12241	4	1473	74.24	2.18	330	2.47	0.9	9	1414	108	5.44	59	2.97	2.47	3.8
34.50	7	1529	77.07	2.23	-12300	7	1480	74.60	2.16	318	2.47	0.9	8	1422	107	5.39	58	2.92	2.47	3.8
35.00	8	1537	77.47	2.21	-12398	7	1487	74.95	2.14	306	2.52	0.9	11	1433	104	5.24	54	2.72	2.52	4.0
35.50	12	1549	78.07	2.20	-12476	14	1501	75.66	2.13	294	2.42	0.9	14	1447	102	5.14	54	2.72	2.42	3.8
36.00	14	1563	78.78	2.19	-12565	7	1508	76.01	2.11	283	2.77	1.0	17	1464	99	4.99	44	2.22	2.77	4.6
36.50	6	1569	79.08	2.17	-12632	3	1511	76.16	2.09	272	2.92	1.0	4	1468	101	5.09	43	2.17	2.92	4.8
37.00	3	1572	79.23	2.14	-12701	9	1520	76.61	2.07	261	2.62	0.9	7	1475	97	4.89	45	2.27	2.62	4.4
37.50	4	1576	79.44	2.12	-12762	3	1523	76.76	2.05	251	2.67	1.0	4	1479	97	4.89	44	2.22	2.67	4.5
38.00	9	1585	79.89	2.10	-12850	7	1530	77.12	2.03	240	2.77	1.0	6	1485	100	5.04	45	2.27	2.77	4.6
38.50	4	1589	80.09	2.08	-12928	8	1538	77.52	2.01	230	2.57	0.9	5	1490	99	4.99	48	2.42	2.57	4.2
39.00	8	1597	80.49	2.06	-13003	8	1546	77.92	2.00	218	2.57	0.9	8	1498	99	4.99	48	2.42	2.57	4.2
39.50	6	1603	80.80	2.05	-13084	9	1555	78.38	1.98	207	2.42	0.9	8	1506	97	4.89	49	2.47	2.42	4.0
40.00	7	1610	81.15	2.03	-13150	14	1569	79.08	1.98	197	2.07	0.7	11	1517	93	4.69	52	2.62	2.07	3.4
40.50	11	1621	81.70	2.02	-13217	10	1579	79.59	1.97	186	2.12	0.7	12	1529	92	4.64	50	2.52	2.12	3.5
41.00	5	1626	81.96	2.00	-13297	9	1588	80.04	1.95	175	1.92	0.7	8	1537	89	4.49	51	2.57	1.92	3.2
41.50	9	1635	82.41	1.99	-13390	6	1594	80.34	1.94	165	2.07	0.7	5	1542	93	4.69	52	2.62	2.07	3.4
42.00	3	1638	82.56	1.97	-13471	7	1601	80.70	1.92	153	1.86	0.7	7	1549	89	4.49	52	2.62	1.86	3.1
42.50	5	1643	82.81	1.95	-13544	7	1608	81.05	1.91	143	1.76	0.6	3	1552	91	4.59	56	2.82	1.76	2.9
43.00	5	1648	83.06	1.93	-13617	12	1620	81.65	1.90	131	1.41	0.5	11	1563	85	4.28	57	2.87	1.41	2.3
43.50	9	1657	83.52	1.92	-13693	7	1627	82.01	1.89	121	1.51	0.5	10	1573	84	4.23	54	2.72	1.51	2.5
44.00	9	1666	83.97	1.91	-13786	6	1633	82.31	1.87	111	1.66	0.6	8	1581	85	4.28	52	2.62	1.66	2.8
44.50	9	1675	84.43	1.90	-13873	4	1637	82.51	1.85	102	1.92	0.7	7	1588	87	4.39	49	2.47	1.92	3.3
45.00	7	1682	84.78	1.88	-13926	5	1642	82.76	1.84	93	2.02	0.7	5	1593	89	4.49	49	2.47	2.02	3.4
45.50	5	1687	85.03	1.87	-13982	9	1651	83.22	1.83	82	1.81	0.6	6	1599	88	4.44	52	2.62	1.81	3.0
46.00	5	1692	85.28	1.85	-14056	8	1659	83.62	1.82	74	1.66	0.6	6	1605	87	4.39	54	2.72	1.66	2.8
46.50	10	1702	85.79	1.84	-14143	2	1661	83.72	1.80	67	2.07	0.7	8	1613	89	4.49	48	2.42	2.07	3.5
47.00	3	1705	85.94	1.83	-14224	6	1667	84.02	1.79	58	1.92	0.7	6	1619	86	4.33	48	2.42	1.92	3.3
47.50	2	1707	86.04	1.81	-14294	7	1674	84.38	1.78	51	1.66	0.6	6	1625	82	4.13	49	2.47	1.66	2.9
48.00	7	1714	86.39	1.80	-14358	3	1677	84.53	1.76	42	1.86	0.6	6	1631	83	4.18	46	2.32	1.86	3.3
48.50	6	1720	86.69	1.79	-14417	6	1683	84.83	1.75	29	1.86	0.6	8	1639	81	4.08	44	2.22	1.86	3.3
49.00	13	1733	87.35	1.78	-14496	8	1691	85.23	1.74	20	2.12	0.7	16	1655	78	3.93	36	1.81	2.12	3.9
49.50	5	1738	87.60	1.77	-14563	7	1698	85.58	1.73	10	2.02	0.7	7	1662	76	3.83	36	1.81	2.02	3.8
50.00	1	1739	87.65	1.79	-14643	4	1702	85.79	1.72	3	1.86	0.6	4	1666	73	3.68	36	1.81	1.86	3.5

APPENDIX H

HAZARD INDEXES BASED ON ACCIDENT HISTORY

H.1 BASIC METHOD

The hazard indexes, whose development and testing is reported on in this report, are deficient in one notable respect: they do not base the hazard on accident history. Thus, although accident history is used in the development and testing of hazard indexes based on other characteristics, the hazard function itself does not have accident history as a component. Although there is not sufficient time to develop such hazard indexes for this report, a method has been developed to do so, and the necessary calculations will be presented in this appendix. The techniques here are being used in a current effort to develop accident history dependent hazard indexes.

The basic idea is simple: one of the variables determining hazard will be the number of accidents actually observed at the crossing during the data period (the year 1975 in this case). A function f(h) has already been developed which gives expected accident frequency in terms of a hazard index h ($f=ce^{2h}$, for example). It is now necessary to develop a function $f_c(h,y)$ which gives the expected number of accidents in a future year, given that the hazard index is h <u>and</u> that y accidents have been observed in a specified prior period (of a specified length in years).

First, the problem is simplified as follows: let $F_c(h,y)$ be the expected number of accidents at a crossing having hazard index h and having had y or more accidents in the year 1975. In particular, $F(h) = F_c(h,1)$ is the expected number of accidents at a crossing whose hazard index is h and which had <u>at least one</u> accident in the data year (1975). It should be remembered that h is a function of crossing characteristics other than actual accident history.

The computation of F(h) will be based on the following lemma: (Y = number of accidents in a year)

$$F_c(h,y) = E(Y|Y\geq y+1,h)Pr(Y\geq y+1|h)/Pr(Y\geq y|h).$$

(see end of this Appendix for derivation and definitions) and in particular:

$$F(h) = E(Y|Y\geq 2,h)\,Pr(Y\geq 2|h)/Pr(Y\geq 1|h).$$

The quantity $E(Y|Y\geq 2,h)\,Pr(Y\geq 2|h)/Pr(Y\geq 1|h)$ can also be written:

(H.1) $$F(h) = E(Y|Y\geq 2,h)\,Pr(Y\geq 2|Y\geq 1,h).$$

The latter quantity can be estimated on every sample which contains crossings for which $Y \geq 1$ (i.e., had an accident). Thus, it may be evaluated for every crossing which had an accident.
Let $\eta_i = 0$ if $Y_i = 1$; $\eta_i = Y_i$ if $Y_i \geq 2$; and η_i be undefined if $Y_i = 0$.
Then $F(h_i)$ is estimated by η_i at sample i. Suppose that:

(H.2) $$F(h) = \ell_1+\ell_2 f.$$

Then ℓ_1 and ℓ_2 can be determined by simple linear regression:

(H.3) $$\hat{\eta}_i = \ell_1+\ell_2 f,\text{ where}$$

ℓ_1 and ℓ_2 are determined by minimizing $\sum_i (\eta_i-\hat{\eta}_i)^2$.
The sum over i is carried only over crossings which had at least one accident, i.e., over the crossings in the accident data base.
$F(h) = \ell_1+\ell_2 f+\ell_3 f^2$ could be similarly optimized.

The quantity F is calculated here as though the data base had no missing accidents. To correct for the missing accidents it is not sufficient to multiply by r, as was done for f (Subsection 2.3.1). However, in the next subsection we use F to make some more calculations internal to the (incomplete) data base, and then, at the end, it is shown how to correct the results for the missing accidents. In the following material notation is switched from F to F* for a reminder that it is calculated on a data base with missing accidents, and that correction for the missing accidents has not been made. One should remember that f (Subsection 2.3.1) has been calculated on the data base with missing accidents, but has been corrected for the missing accidents. The designation f^* is now introduced to denote f uncorrected for the missing accidents; then $f^* = \frac{f}{r}$ (by definition).

It is useful to mention some partial results which will illustrate the magnitudes involved. The numbers given here for ℓ_1 and ℓ_2 are to be taken as tentative, since the limits of accuracy have not been adequately assessed. A preliminary regression of the form

$$F^* = \ell_1 + \ell_2 f^* \tag{H.4}$$

was run for crossbucks, flashing lights, and automatic gates. This amounts to a strong limitation on the form of F^*, as it is forced to be a linear function of f alone (and not directly of C, T, number of tracks, etc.). The results are shown in Table H-1.

Table H-1

$F^* \approx \ell_1 + \ell_2 f^*$

Warning Device Class	ℓ_1	ℓ_2
Crossbucks	0.044	1.78
Flashing lights	0.085	1.68
Automatic gates	0.13	1.52

(Results are preliminary. Automatic gates case is subject to larger errors than the other two cases.)

That F^* is valid internal to the data base and has not been corrected for missing (unlinked) accidents. Similarly,

$$f^* = \frac{f}{r}.$$

In Table H-1 the results for crossbucks and flashing lights are more reliable than those for automatic gates, which were calculated for 614 points only (total number of gate crossings with repeat accidents). Note that one equation covers both flashing lights and crossbucks in a very approximate manner:

$$F^* \approx f^*_{(.25)} + 1.7f^*$$

where $f^*_{(.25)}$ represents the 25th percentile from the top of f^* for the particular warning device class, i.e., for that warning device class one-fourth of the crossings have f^* greater than $f^*_{(.25)}$.

H.2 ACCIDENT HISTORY DEPENDENT HAZARD INDEX

The approach just discussed uses equation H.1 (Section H.1) which is based only on the assumption that inherent hazard does not change over time. It is necessary to make such an assumption in any application of accident history.

A procedure is now outlined (using the one just developed) which provides a much more complete means of incorporating accident history into the calculation of hazard indexes (expected frequency of accident during a future time interval -- thus, absolute indexes). For a future year the expected number of accidents at a particular crossing will be calculated having given inventory characteristics and a past history of a given number of accidents in a specified time period. The goal of this calculation can be stated even more concisely: Given a crossing with specified characteristics, and given the fact that n accidents occurred in T years, find the expected number of accidents for that crossing for next year.

For this analysis the above assumption of constancy of inherent hazard with time and some other assumptions as well, are necessary. One draws on the techniques of empirical Bayscian analysis, References 9 and 10. (See Reference 9 for an application to determine insurance premium penalties for drivers based on their accident records as well as on other characteristics.)

In describing accident proneness, one customarily assumes that the specific hazard per unit time, ϕ, is not the same for all individuals (in this case crossings), but instead, has a gamma distribution with parameters a and b as indicated in H.5:

$$\text{(H.5)} \qquad Pr(\phi<\phi_o) = \frac{b^a}{\Gamma(a)}\int_0^{\phi_o} \lambda^{a-1}\ e^{-\lambda b}\ d\lambda$$

(The gamma distribution with its two parameters is a "natural conjugate prior" distribution to the Poisson distribution which is introduced presently, and is required on theoretical grounds, given the time homogeneity assumption. See Reference 10.) In the present treatment, a and b are to be functions of the crossing characteristics, as recorded in the crossing inventory, or alternatively, as reflected in f* and F*, so that a and b are functions of f* and F*.

Based on the time homogeneity assumption, the probability of r accidents in T years at a crossing with a specific hazard, ϕ, has the Poisson distribution of Equation H.6:

$$\text{(H.6)} \qquad Pr(r=n) = \frac{(\phi T)^n e^{-\phi T}}{n!}$$

This, together with equation H.5, yields a probability distribution for the number of accidents in a year at a crossing, with ϕ unknown but a and b known. The distribution is a negative binomial distribution with parameters a and b:

$$\text{(H.7)} \qquad P(n) = \begin{bmatrix} a+n-1 \\ a-1 \end{bmatrix} \left(\frac{b}{1+b}\right)^a \left(\frac{1}{1+b}\right)^n$$

(Reference 9 notes the custom of using the negative binomial to describe "accident proneness", and notes other references on this topic. Note that it is characteristic of the empirical Bayes procedure that a specific hazard, ϕ, is postulated but not known, and not even directly estimated.)

The negative binomial distribution results in a mean number of accidents of $\frac{a}{b}$, which, in turn, is the unconditional expected frequency of accidents, f* (for the data base at hand):

$$\text{(H.8)} \qquad f^* = \frac{a}{b}$$

Similarly, from the expression for F, which is here to be interpreted as F* in Equation (H.1), one derives.

$$F^* = \frac{f^* - P(1)}{1 - P(0)} \qquad \begin{cases} P(1) = \text{probability of one accident} \\ P(0) = \text{probability of zero accidents} \end{cases}$$

or, using Equation (H.7),

$$\text{(H.9)} \qquad F^* = \frac{f^* - \left[\frac{b}{1+b}\right]^a \left[\frac{a}{1+b}\right]}{1 - \left[\frac{b}{1+b}\right]^a}$$

In the above equations f* and F* are used instead of f and F as a reminder that these quantities are not corrected for the missing accidents, but are calculated for the data base at hand. Thus, $f^* = \frac{f}{r}$, as noted in Section H.1 (see also Subsection 2.3.1). If one is given f* and F* for each crossing, one can determine a(f*, F*) and b(f*, F*) by solving equations (H.8) and (H.9).

It then follows, from Bayesian analysis, that if n accidents are observed in T years with a crossing whose characteristics yield the values f* and F*, then the expected number of accidents in any future year is given by $\bar{\Phi}^*(f^*,F^*,n,T)$:

$$\text{(H.10)} \qquad \bar{\Phi}^* = \frac{a}{b+T} + \frac{n}{b+T}$$

Note that from equation (H.10), with T=0 and n=0, one gets the value f* which is the expected accident frequency conditioned on no accident history. With T=1 and n≥1, and with some algebraic operations, one can also derive equation (H.1) from equation (H.10). This is a reassuring check. [Equation (H.1) is, as noted, based on fewer assumptions than is equation (H.10).] As f* and F* have been calculated on a data base with a fraction $1 - \frac{1}{r}$ of the accidents missing (unlinked), then this is corrected for simply by dividing b in equation (H.10) by r (from Subsection 2.3.1, r=1.41):

$$\text{(H.10a)} \qquad \bar{\phi} = \frac{a}{\frac{b}{r}+T} + \frac{n}{\frac{b}{r}+T}$$

Equation (H.10a) now solves the problem of finding a hazard index with full dependence on accident history (for any period of time). It can even be used to rank together crossings for which the accident history is known for different numbers of years (since $\bar{\phi}$ is an absolute hazard index and provides an expected frequency of accidents). However, it could be expected to work best if all crossings had an accident history over the same time period.

Now the procedure for calculating a and b as functions of f* and F* will be recapitulated and expanded on. To solve equations (H.8) and (H.9), they are transformed as follows:

$$\text{(H.11)} \qquad a = bf^*$$

$$\text{(H.12)} \qquad b_2 = \frac{\log\left(1 + \frac{f^*}{(1+b_1)(F^*-f^*)}\right)}{f^*\log\left(1+\frac{1}{b_1}\right)}$$

If a reasonable approximation for b is substituted for b_1 on the right-hand side of equation (H.12), then this equation yields a better approximation as b_2. This new approximation can be put back in equation (H.12) as b_1, resulting in a still better approximation as b_2. This process can be iterated several times. It happens, however, that when $f^* \geq 1$, a fairly good initial approximation for b is available [equation (H.13)]:

$$\text{(H.13)} \qquad b \approx \frac{1}{(F^*-f^*)\left(1+\frac{F^*}{2}\right)}$$

This is surprisingly accurate when F* and f* are not too large, as can be seen by substituting in equation H.12. For example, if f*=0.33 and F*=0.69, the error in equation (H.13) is less than

4 percent. In general, equation (H.13) will provide an initial estimate to be used as b_1 in equation (H.12). The resulting b_2, if changed but slightly, is to be used for b_1 or else b_2 is substituted for b_1 to iterate the process.

It has now been shown how to calculate a and b (analytically) as functions of F* and f*. There are not empirical data involved in such a calculation, since a and b are determined as implicit functions of F* and f* by equations (H.8) and (H.9), or by equations (H.11) and (H.12).

It has already been shown how F* could be found as a simple function of f* [e.g., equations (H.3) and (H.4)]. F* could be found as a function of other crossing characteristics as well (e.g., as its own function of volume variables, etc.). However, for simplicity, if F* is found only as a function of f*, then a and b become functions of f* alone. Thus, when this analysis is carried out in full, a table will probably be given in the following form:

% Crossings	f*	F(f*)	a(f*)	b(f*)
0.5	.	.	.	.
1.0	.	.	.	.
1.5	.	.	.	.
2.0	.	.	.	.
.	.	.	.	.
.	.	.	.	.
.	.	.	.	.
49.0	.	.	.	.
49.5	.	.	.	.
50.0	.	.	.	.

Some preliminary results on F* as a linear function of f* have been given in this Appendix [equation (H.4) and Table H-1]. Much more precise statements can be made about the functional dependence of F* on f*. The rough guide is just an indication; further regressions should yield fairly accurate functional relationships.

Having a and b as functions of f*, equation (H.10) now yields $\bar{\phi}$ as a function of f*, T, and n, thus completing the solution for the hazard index which depends on accident history.

When the detailed computations and the results for a and b as functions of f are given, an evaluation in the manner of the EOCs given for the ordinary hazard indexes should be included. (It will be informative to see how much accident history may enhance a hazard index.)

It is instructive to illustrate the various formulas of this section by a simple example. Suppose one is given a crossbuck crossing for which accident history has been collected for five years, during which two accidents occurred (T=5, n=2). Suppose, also, that h_{TSC} = -0.186 (from formula B.5.1.3). Then, from the formula in Subsection 2.3.1, f=0.230, and

$$f^* = \frac{f}{r} = \frac{0.230}{1.41} = 0.163$$

From equation (H.4),

$$F^* = 0.044 + (1.78)(0.163) = 0.334$$

Then, from equation (H.13), b ≈ 5.01. Substituting b_1 = 5.01 in equation (H.12), one gets b_2 = 4.96. One now has available the following values for the parameters appearing in equation (H.10a):

a = (0.163)(4.96) = 0.8085

b = 4.96

n = 2

r = 1.41

T = 5

Substituting in equation (H.10a), one obtains

$$\bar{\phi} = \frac{0.8085}{\frac{4.96}{1.41}+5} + \frac{2}{\frac{4.96}{1.41}+5} = 0.33$$

Thus, the expected accident frequency per year, given two accidents in five years (of observation), is 0.33. This value lies between the unconditional frequency, 0.23, and the observed frequency, 0.4, i.e., $\frac{2}{5}$, as it must.

Another look at equation (H.10a) provides an additional approach in assessing the significance of $\bar{\phi}$. Letting $T_o = \frac{b}{r}$, and recalling the relation $f=rf^* = r.\frac{a}{b}$, one applies simple algebra to arrive at the following transformation of equation (H.10a).

$$\bar{\phi} = \frac{a}{\frac{b}{r}+T} + \frac{n}{\frac{b}{r}+T}$$

$$= \frac{ra}{b}\left[\frac{1}{1+\frac{T}{\left(\frac{b}{r}\right)}}\right] + \frac{n}{\frac{b}{r}+T}$$

$$= f.\frac{T_o}{T+T_o} + \frac{n}{T+T_o}$$

(H.14) $$\bar{\phi} = f.\frac{T_o}{T+T_o} + \frac{n}{T} . \frac{T}{T+T_o}$$

Equation (H.14) shows that $\bar{\phi}$ is a weighted average of f (the unconditional expected accident frequency) and $\frac{n}{T}$ (the observed accident frequency). When $T = T_o$, the two terms have equal weight: $\frac{T_o}{T+T_o} = \frac{T}{T+T_o} = \frac{1}{2}$. One can estimate T_o from the formulas of this subsection. In the example given above, $T_o = \frac{4.96}{1.41} = 3.5$ years. General orders of magnitude may be noted: for crossings more hazardous than the least hazardous 70 percent and less hazardous than the most hazardous 5 percent, i.e., between the 5th and 30th percentiles from the top, one has:

Crossbucks : $5.4<T_o<10.4$ years
Flashing lights: $2.4<T_o< 4.5$ years

In both cases, $0.4 \leq fT_o \leq 0.8$ in this limited range. In general, as f gets larger, T_o gets smaller. Apparently, as f gets larger, fT_o gets larger.

H.3 DEFINITIONS:

$E(Y|h)$ is "the expected value of the number of accidents Y, given that the hazard index has the value h". $E(Y|Y\geq y,h)$ is "the expected number of accidents in a year, Y, given the hazard index and that Y is greater than or equal to y." $Pr(Y\geq y+1|h,Y\geq y)$ means "the probability that the number of accidents in a year equals or exceeds y+1, given that it equals or exceeds y and given h."

H.4 DERIVATION OF LEMMA

Let ε be a very small fraction ($\varepsilon<<1$).

Y_ε = number of accidents in ε of a year;

$Y_{1-\varepsilon}$ = number of accidents in remaining $1-\varepsilon$ of that year;

Y_1 = number of accidents in a certain year;

Y_2 = number of accidents in another year

$Y = Y_\varepsilon + Y_{1-\varepsilon}$ (All at crossing with hazard index value h)

Then:

$$Pr(Y_\varepsilon=1|Y_{1-\varepsilon}\geq y,h) = \frac{Pr(Y_\varepsilon=1,\ Y_{1-\varepsilon}\geq y|\ )}{Pr(Y_{1-\varepsilon}\geq y|h)}$$

$$= \sum_{x=y+1}^{\infty} \frac{Pr(Y_\varepsilon=1,\ Y_{1-\varepsilon}=x-1|Y-x)Pr(Y-x|h)}{Pr(Y_{1-\varepsilon}\geq y|h)}$$

$$\approx \sum_{x=y+1}^{\infty} \varepsilon\ x\ Pr(Y=x|h)/Pr(Y\geq y|h).$$

But,

$$Pr(Y_\varepsilon=1|Y_{1-\varepsilon}\geq y,h) \approx \varepsilon\ E(Y_2|Y_1\geq y,h)$$

Therefore, letting $\varepsilon \to 0$

$$E(Y_2|Y_1\geq y,h) = E(Y|Y\geq y+1,h)\ Pr(Y\geq y+1|h)/Pr(Y\geq y|h)$$

$$= E(Y|Y\geq y = 1,h)\ \ Pr(Y\geq y+1|Y\geq y,h)$$

This formula is exact, and based only on very weak assumptions of homogeneity in time.

REFERENCES

1. California Public Utilities Commission: "The Effectiveness of Automatic Protection in Reducing Accident Frequency and Severity at Public Grade Crossings in California," 1974.

2. J. Coleman and G. Stewart: "Investigations or Accident Data for Railroad-Highway Grade Crossings, "Transportation Research Record Number 611, 1976.

3. Rail-Highway Grade-Crossing Accidents/Incidents Bulletin, U.S. Department of Transportation, Federal Railroad Administration, Office of Safety, 1975 (other years available).

4. Summary Statistics of the National Railroad-Highway Crossings, Inventory for Public At-Grade Crossings, U.S. Department of Transportation, Federal Railroad Administration, Report FRA-OPPD-77-8 (prepared at Transportation Systems Center, Cambridge, Massachusetts)

5. Robert A. Lavette: "Development and Application of a Railroad-Highway Accident Prediction Equation," Transportation Research Record Number 628, p. 12, 1976.

6. D. R. Cox: "Analysis of Binary Data," Halstead Press/John Wiley, New York, 1970, 142 p.

7. F. H. Mosteller and J. W. Tukey: "Data Analysis and Regression: A Second Course in Statistics," Addison-Wesley, Reading, Massachusetts, 1977, 606 p.

8. H. A. Richards and G. S. Bridges: "Railroad Grade Crossings," Chapter 1.1 of "Traffic Control and Roadway Elements--Their Relationship to Highway Safety," Department of Transportation Institute, Texas A&M, 1968.

9. J. Ferreira, Jr.: "Some Analytical Aspects of Driver Licensing and Insurance Regulation," Technical Report No. 58, Operations Research Center, Massachusetts Institute of Technology, Cambridge, Massachusetts, 1971.

10. H. Raiffa and R. Schlarfer: "Applied Statistical Decision Theory," M.I.T. Press, Cambridge, Massachusetts, 1961.

11. L.E. Peabody and T.B. Dimmick: "Accident Hazard at Grade Crossings," Public Roads, Federal Highway Administration, Washington DC, August 1941.

12. D.A. Zalinger, B.A. Rogers, and H.P. Johri: "Calculation of Hazard Indices for Highway-Railway Crossings in Canada," Accid. Anal. & Prev., Vol 9, pp. 257-273, Pergamon Press, 1977.

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