Sequential Analysis Guidelines

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Abstract

This paper describes the context in which the requirement for a sequential analysis was developed and provides technical guidelines for performing the analysis. The types of data needed to perform a sequential analysis are discussed and detailed examples of two approaches are presented. A sequential analysis proceeds one step at a time. The key task is measuring the influence of prior rating factors and adjusting for it. The *loss residual* approach is based on evaluating the variations in losses that have not been accounted for by previous factors. The *prior relativities* approach is based on adjusting a rating factor's relativities by the average relativity of prior factors. Both approaches are mathematically equivalent and produce the same results. The spreadsheet instructions needed to implement the prior relativities approach for two different types of algorithms each with two different ways of handling the good driver discount are completely worked out in examples.

Introduction

The term sequential analysis as is it is used in this paper refers to a technique for analyzing loss data to determine indicated relativities. These indicated relativities are associated with the categories of rating factors that are part of a private passenger automobile rating plan. The concept of performing a sequential analysis took on increased importance in California after the passage of Proposition 103. Prior to Proposition 103, insurers were generally free to determine rates using any acceptable actuarial method. Proposition 103 eliminated some of insurers' discretion to design private passenger automobile insurance rates. In 1989, prior to the many public hearings held by the Department, the prior Commissioner appointed a committee to advise her on the issues related to implementing Proposition 103. Among the committee's recommendations was that regulations be issued requiring a sequential analysis as part of the rate development process. The sequential analysis requirement has been a part of all related regulations since that time. The purpose of this paper is to describe methods for performing a sequential analysis that are in compliance with the regulations (California Code of Regulations, Title 10, Section 2632) that have been recently approved by the Office of Administrative Law. (These regulations were commonly referred to as the RH-338 or auto rating factor regulations). **While we are not aware of other methods that meet the requirements of the regulations, if compliance can be demonstrated, another method could be used for performing the sequential analysis.**

It should be noted that performing a sequential analysis is only one step in developing a rating plan that meets the requirements of Proposition 103. After the sequential analysis is completed, it is necessary to evaluate the indicated relativities and to select the actual relativities that will be used in the premium calculation algorithm. Once selected relativities are determined, it is necessary to calculate the weights of the rating factors and ensure they are in the correct order. These additional steps are beyond the scope of this paper.

The regulations that implement the portion of Proposition 103 dealing with auto rating factors requires "The determination of the initial relativities to associate with a rating factor shall be established by performing a sequential analysis. The sequential analysis shall remove the variation in loss costs already explained by prior factors."[1] The concept of sequential analysis requires that rating factors be taken in the order prescribed in the regulations, one at a time. Each factor is analyzed in its turn to determine the loss costs associated with it. These loss costs are generally described as indicated relativities. The key to meeting the requirement is removing the variation or influence on loss costs accounted for by prior factors before determining the relativities for the rating factor next in the sequence. The general approach taken in a sequential analysis is illustrated in Figure 1.

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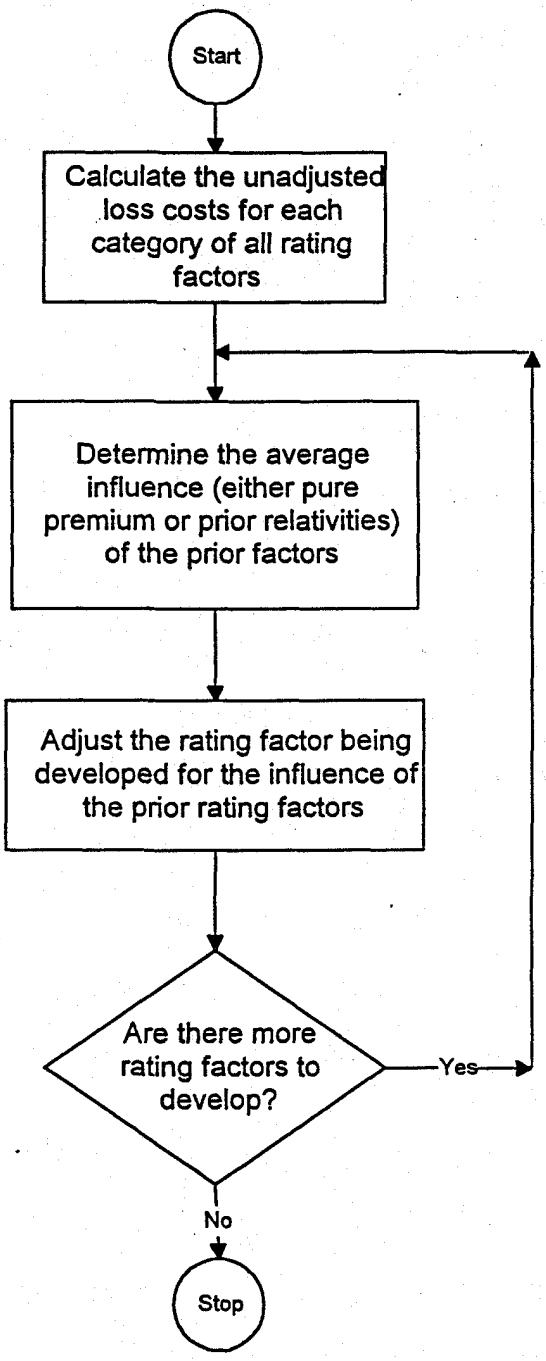
[1]In the language of the regulations the "initial relativities" are the first set of relativities for which factor weights are calculated. These relativities are either the indicated relativities from the sequential analysis or are determined by evaluating the indicated relativities from the sequential analysis and selecting the actual relativities to use. If the factor weights are not in the required order the initial relativities are either pumped or tempered and "new relativities" are calculated. In such cases, the new relativities replace the initial relativities for premium calculation purposes.

Figure 1. The Sequential Analysis Process



In order to remove the influence of prior factors, a *step-by-step* procedure must be used. Approaches that consider all factors at one time, such as multiple regression analysis, do not meet the requirement that the influence of prior factors be removed before determining the relativities of a new factor. Similarly, approaches that proceed in a step-by-step fashion but do not adjust for

the effect of the prior factors do not meet the new regulation requirements.

As previously noted that the process of *selecting* the specific relativities to associate with a rating factor for the purposes of the class plan filing is separate from the sequential analysis. The purpose of the sequential analysis is to document the rating factor's relationship to the underlying loss data. At each step in the sequential analysis the prior relativities or pure premium based on prior factors is determined by using the indicated relativities of the prior factors. (If the selected relativities for a factor are significantly different than the indicated relativities, an insurer may wish to perform another sequential analysis. This second sequential analysis would be based on the selected relativities and would show new indicated relativities for subsequent factors and could provide useful information for selecting the relativities of subsequent factors.)

There are only two approaches that we are aware of for performing a sequential analysis that rigorously controls for the variation in loss costs already explained by the prior factors. One is a *relativities* oriented method, the other is a *residual* oriented method. The goal of both approaches is the same; however, the information used by each method is slightly different.

Data Needed for a Sequential Analysis

The type of data needed to perform a sequential analysis depends on the approach used (i.e., either prior relativities or loss residuals) to perform the analysis. How the data are manipulated depends on the type of premium calculation algorithm used. On a practical basis, individual records are required for any other algorithms besides a exclusively additive algorithm (i.e., of the form: Premium = Base Pure Premium * $(1.0 + F_1 + F_2 + F_3 + \ldots)$).[2] These records need to link losses to individual vehicles. The data needed includes losses, exposures, and the rating factors associated with the vehicle.

For exclusively additive algorithms[3], it may be practical to perform a sequential analysis using summary data. This summary data includes the unadjusted indicated loss or relativity for each category of the rating factors to be used, and the two-way cross distribution of exposures for each factor prior to the factor being developed (e.g., for F_3, $F_1 \times F_3$ and $F_2 \times F_3$ would be needed).

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[2]The notation $F_1, F_2, F_3, \ldots$ is used to indicate the first, second, third, etc. factors in the sequential analysis. Section 2632.7(b) of the regulations specifies the order in which the factors are to be analyzed.

[3]It should be noted that Section 2632.12(a) of the regulations has the effect of prohibiting an exclusively additive algorithm. This section requires "The good driver discount [GDD] must be applied after the total premium is developed . . . ." Thus an additive algorithm would have to be modified to take the form: Premium = Base Pure Premium * $(1.0 + F_1 + F_2 + F_3 + \ldots)$ * GDD. An additive algorithm thus modified is no longer a "exclusively additive algorithm." However, if the GDD requirement is ignored while the rating factors are developed (see the section "Treatment of GDD"), a sequential analysis could proceed as if an exclusively additive algorithm were being developed. Even if the GDD is taken into account while developing the rating factors for a "mostly additive algorithm," it is still possible to perform a sequential analysis with summary data. It is just more complicated. The methods for performing a sequential analysis using summary data for a mostly additive algorithm (i.e., a exclusively additive algorithm modified to include a multiplicative GDD factor) are shown in section II of this paper.

Theoretically, it is possible to perform a sequential analysis for a multiplicative algorithm using summary data. The practical problem is that in order to remove the influence of prior factors, it is necessary to determine a N-way distribution of the rating factors, where N is the number of all possible combinations of rating factor categories. The size of the N is determined by the number of categories in each rating factor ($N = n_1 * n_2 * n_3 * \ldots$, where n_i is the number of categories in the i^{th} rating factor). If only a few factors are used or only a few categories are used on most of the factors, then an approach utilizing summary data may be practical. However, with many factors or many categories, N becomes so large that the procedure becomes impractical.

The examples discussed in the following sections describe procedures that use individual records. Attachments A and C describe the procedures to use with summary data and a multiplicative algorithm. Attachments B and D describe the procedures to use with summary data and an additive algorithm. These detailed examples show how to implement a sequential analysis using summary data in a spreadsheet.

Data Used in Examples

To illustrate the basic methodology of the different approaches a simplified premium calculation algorithm using only three simplified factors is used. A separate section expands on the simplified algorithms by adding the good driver discount (GDD) to the sequential analysis process. The procedure shown in the examples can be extended to algorithms that use more factors and factors that use more categories. The basic method remains the same. The three factors and their categories are:

1. Safety Record:	0 points
	1 point
	2 or more points
2. Mileage:	low
	medium
	high
3. Years Licensed:	0 to 7
	8 to 14
	15 or more

The distribution of vehicles and the loss data shown in the examples are actual loss data from a large California insurer. In order to reduce the demand on computer resources and program run times, the data file used for the examples was created by selecting a random sample of the records from one year. The sample data file that was created contained loss data for just over 200,000 vehicles. These records were then weighted by a variable measuring the exposure for the year. After weighting, the sample loss records represented about 150,000 vehicle years of exposure.

Treatment of the GDD

The final version of the regulations contains no references to the GDD in the section on sequential analysis (2632.7). The key issues regarding the GDD that must be addressed when performing a sequential analysis are: 1) how should the effect of the GDD be considered when developing the other factors, and 2) how should the magnitude of the discount be determined.

Regarding the magnitude of the GDD, the GDD requirement as it is stated in Section 2632.12(a) of the regulations requires that drivers who qualify for the GDD "shall be charged a rate that is at least 20 percent less . . ." than a driver not qualifying for the GDD. This language combined with the requirement of Section 2632.7(c) (initial relativities of multiplicative factors must have a weighted average of 1.0) allows the relativities for the GDD factor to be determined by a formula[4] of the type:

$$y = 1 / (1 - (0.2 * x)) \qquad [1]$$

where,

y	= the relativity for vehicles not qualifying for a GDD
$0.8 * y$	= the relativity for vehicles qualifying for a GDD
x	= the percent of vehicles qualifying for the GDD expressed as a decimal

Some GDD relativities for various percent of vehicles qualifying for the GDD are:

% Qualifying for GDD	Relativity for non-GDD	Relativity for GDD
85%	1.205	0.964
90%	1.220	0.976
95%	1.235	0.988

In the sample data used in the examples that follow 93.4% of the vehicles qualify for the GDD. This translates into relativities of 0.984 and 1.230 for the GDD.

It is also possible to determine the magnitude of the GDD by an analysis of loss costs (subject to the requirement that the discount be a minimum of 20%). If the size of the GDD is determined by an analysis of loss costs, *when* this determination is made in the sequential analysis process is critical. If the GDD is analyzed before any other rating factor, the increase in rates from good driver to non-good driver could be 80% to 100% or more. A GDD of this magnitude could result in a counter intuitive safety record factor when it is subsequently developed. This is due to the large overlap between the GDD and safety record. If the GDD is analyzed after all the other factors are developed, there could be so little unexplained variation in loss costs that the indicated magnitude of the discount is substantially below the required 20% minimum. In such a situation setting the discount to the 20% minimum would cause the rating plan to make a substantial deviation from loss costs. Some insurers may wish to avoid this type of situation to the extent that it is possible.

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[4]This particular formula assumes that the GDD is implemented in such a way to provide the minimum 20% difference required by the regulations and that the weighted average of the factor is 1.0. It is the result of solving the following equation for y: $((1 - x) * y) + (x * 0.8 * y) = 1.0$. If an insurer wished to implement the GDD with a higher discount, say 25%, then the 0.2 in formula [1] would be replaced by the decimal equivalent of the higher discount. If the higher discount was chosen to be 25% the 0.2 would be replaced by 0.25. The relativity for the drivers qualifying for a GDD would then be $0.75 * y$ (instead of the $0.8 * y$ that is shown above).

Intertwined with the issue of the magnitude of the GDD is how the GDD's effect should be considered when developing the other factors. In the regulations, the GDD is generally considered a requirement of the Proposition rather than a rating factor. The GDD is not considered in the part of the regulations that define the mandatory and optional rating factors, how loss data is to be analyzed to determine initial relativities, and how weights for the rating factors are to be determined (Sections 2632.5, 2632.7, and 2632.8). Because the regulations do not specify a specific direction, varying interpretations could be possible. In this paper two approaches towards the GDD are considered: 1) take into account the effect of the GDD when developing all of the rating factors, and 2) ignore the effect of the GDD when developing all of the rating factors. The two approaches produce very different consequences.

As the GDD requirement is a condition imposed by Proposition 103 it is reasonable to consider the effect of this requirement when developing the rating factors. A positive aspect of this approach is that the resulting rating plan is based on loss costs and more accurately reflects the risk of loss. A negative aspect is there is somewhat more work involved in dealing with one more "factor." Also, in the case of a mostly additive algorithm, the sequential analysis process is more complicated. The additional complications are necessary to control for factor interactions among the non-additive factors. This increased complexity only affects plans using the mostly additive algorithm, exclusively multiplicative algorithms follow a similar procedure regardless of when (or if) the GDD is introduced into the sequential analysis.

A positive aspect of ignoring the effect of the GDD when developing the rating factors is that there is one less step in the sequential analysis process. Also, the procedure for a mostly additive algorithm is computationally less complex. A negative aspect is that the rating plan that ignores the GDD in the development of the rating factors may develop rates that are significantly different from the risk of loss. The result could be good drivers receive an unearned discount while non-good drivers could receive an unearned surcharge. If the magnitude of these deviations is substantial there could be a problem of inadequate rates for good drivers or excessive rates for non-good drivers.

The remainder of this paper is divided into two major sections. The first section deals with performing a sequential analysis where the GDD is ignored while the rating factors are developed. In the second section, the effect of the GDD is considered when developing the rating factors. Each section contains subsections that describe how to perform a sequential analysis using the loss residual approach, the prior relativities approach, and with summary data.

Two different types of algorithms are used in the examples in each section: a multiplicative algorithm, and an additive algorithm. In section I, the multiplicative example algorithm has the form:

$$\text{Premium} = \text{Base Pure Premium} * F_1 * F_2 * F_3$$

and the additive example algorithm has the form:

$$\text{Premium} = \text{Base Pure Premium} * (1.0 + F_1 + F_2 + F_3)$$

It should be noted that the examples shown in section I are not complete in that they would still need to have a GDD factor added to the algorithm (as discussed above) to meet the requirement of the regulations. In section II, the multiplicative example algorithm has the form:

$$\text{Premium} = \text{Base Pure Premium} * F_1 * F_2 * F_3 * \text{GDD}$$

and the additive example algorithm has the form:

$$\text{Premium} = \text{Base Pure Premium} * (1.0 + F_1 + F_2 + F_3) * \text{GDD}$$

I. GDD Ignored in Factor Development

In this section the GDD is ignored while the rating factors are developed. As the GDD does not play a role in factor development, it is excluded from the summary tables of this section. In practice, after the factors are developed, the GDD is either set to provide the 20% minimum discount or is determined by an analysis of loss costs, then algorithms similar to those shown in section II are used to compute the premium.

Loss Residuals Approach

The loss residual approach uses two key items of information for each category of the factor being analyzed: (a) the average pure premium based on prior factors (PPBOPF) and (b) the unadjusted average loss. Subtracting the average PPBOPF from the average unadjusted loss gives the loss residual.

$$\text{Loss Residual} = \text{Unadjusted Average Loss} - \text{Average PPBOPF} \qquad [2]$$

The unadjusted average loss is a summary of the losses associated with each category of the factor. It is computed by summing the losses associated with a category and dividing by the number of exposures and contains no adjustments for any other rating factors.

$$\text{Unadjusted Average Loss} = \Sigma_{\text{cat.}} \text{Losses} / \Sigma_{\text{cat.}} \text{Exposures} \qquad [3]$$

For a multiplicative factor the *adjusted* indicated relativity is 1.0 plus the loss residual divided by the average PPBOPF (see formula [6]), where the base pure premium is the average pure premium for all vehicles. For additive factors the adjusted indicated relativity is the loss residual divided by the Base Pure Premium (see formula [7]). The number of factors used in the formula for PPBOPF depends on which step of the sequential analysis is being performed. All factors prior to the factor being developed are included. The general formula for the PPBOPF of the i^{th} rating factor is calculated by the following formulas:

$$\text{PPBOPF} = \text{(multiplicative algorithm)}$$
$$\text{Base Pure Premium} * F_1 * F_2 * F_3 * \ldots * F_{i-1} \qquad [4]$$

(additive algorithm)

$$\text{Base Pure Premium} * (1.0 + F_1 + F_2 + F_3 + \ldots + F_{i-1}) \qquad [5]$$

Where,

F_1 = Adjusted Indicated Relativity for the first factor
F_2 = Adjusted Indicated Relativity for the second factor
F_3 = Adjusted Indicated Relativity for the third factor

(for the Loss Residual Method):

Adjusted Indicated Relativity = (multiplicative algorithm)

$$1.0 + (\text{Loss Residual} / \text{average PPBOPF}) \qquad [6]$$

(additive algorithm)

$$= (\text{Loss Residual} / \text{Base Pure Premium}) \qquad [7]$$

$$\text{Base Pure Premium} = \Sigma_{all}\ \text{Losses} / \Sigma_{all}\ \text{Exposures} \qquad [8]$$

In the first pass through the data the unadjusted average loss is calculated for all categories of all the rating factors. At this time there are no prior factors and the PPBOPF for the categories of the first factor is simply the base pure premium (where the base pure premium is the average loss for all vehicles). The loss residual (formula [2]) for each category of the first factor is its unadjusted average loss minus the average PPBOPF. The adjusted indicated relativity for the category is 1.0 plus the loss residual divided by the base pure premium (formula [6] for multiplicative algorithms) or the loss residual divided by the base pure premium (formula [7] additive algorithms).

In the second pass through the data the PPBOPF is computed for each vehicle using the base pure premium and the indicated relativities of the *first* factor. The average PPBOPF is then computed for each category of the second factor. The loss residual is computed by subtracting the average PPBOPF from the unadjusted average loss. The adjusted indicated relativities are calculated following the same procedure used for the first factor.

In the third pass through the data the PPBOPF is computed for each vehicle using the base pure premium and the indicated relativities of the first *two* rating factors. The average PPBOPF is then computed for each category of the third factor. The loss residual is computed by subtracting the average PPBOPF from the unadjusted average loss. The adjusted indicated relativities are calculated following the same procedure used for the first factor.

If there were additional rating factors in the premium algorithm this process of passing through the data, computing a PPBOPF, calculating the average PPBOPF for the new factor's categories, computing the loss residual, and finally the adjusted indicated relativities would be repeated for each subsequent factor.

Figure 2 shows the results of these procedures applied to the sample data. It is interesting to note how the resulting indicated relativities for the two different types of algorithms are fairly similar. However, in pass 3 a slight difference can be noted in the average PPBOPF. This difference is due to the interaction effects that are included in the multiplicative algorithm and not included in the additive algorithm. Depending on the underlying distribution of exposures and as more factors are added to the algorithms, the potential for differences between the multiplicative and additive approaches increase.

Figure 2. Sequential Analysis via the Loss Residual Method
A. Multiplicative Algorithm: Premium = Base pure premium * F_1 * F_2 * F_3

	Categories	Average PPBOPF	Unadjusted Average Loss	Loss Residual	Adjusted Indicated Relativity
Pass 1.					
Safety	0	155.05	149.28	-5.77	0.96
Record	1	155.05	183.79	28.73	1.19
	2+	155.05	213.58	58.52	1.38
	average	155.05	155.05	0.00	1.00
Pass 2.					
Mileage	low	153.74	133.35	-20.40	0.87
	medium	155.18	150.24	-4.94	0.97
	high	155.98	207.76	51.78	1.33
	average	155.05	155.05	0.00	1.00
Pass 3.					
Years	0 - 7	159.86	248.17	88.31	1.55
Licensed	8 - 14	160.19	159.72	-0.47	1.00
	15 +	152.97	135.63	-17.34	0.89
	average	155.05	155.05	0.00	1.00

Figure 2 (continued)
B. Additive Algorithm: Premium = Base pure premium * $(1.0 + F_1 + F_2 + F_3)$

	Categories	Average PPBOPF	Unadjusted Average Loss	Loss Residual	Adjusted Indicated Relativity
Pass 1.					
Safety	0	155.05	149.28	-5.77	-0.04
Record	1	155.05	183.79	28.73	0.19
	2+	155.05	213.58	58.52	0.38
	average	155.05	155.05	0.00	0.00
Pass 2.					
Mileage	low	153.74	133.35	-20.40	-0.13
	medium	155.18	150.24	-4.94	-0.03
	high	155.98	207.76	51.78	0.33
	average	155.05	155.05	0.00	0.00
Pass 3.					
Years	0 - 7	159.84	248.17	88.33	0.57
Licensed	8 - 14	160.21	159.72	-0.49	0.00
	15 +	152.97	135.63	-17.34	-0.11
	average	155.05	155.05	0.00	0.00

Note: Loss residuals may be affected by rounding.

Prior Relativities Approach

In the prior relativities approach the focus is on the impact of the relativities from prior factors. The two key items of information are: (a) the average prior relativities from prior factors (PRFPF) and (b) the unadjusted indicated relativity. The PRFPF is computed using relativities of prior factors. The formulas for the i^{th} rating factor are:

PRFPF =

(multiplicative algorithm)

$$F_1 * F_2 * F_3 * \ldots * F_{i-1} \qquad [9]$$

(additive algorithm)

$$(F_1 + F_2 + F_3 + \ldots + F_{i-1}) \qquad [10]$$

The unadjusted indicated relativity is based on the unadjusted average loss that is computed as described in formula [3] in the "Loss Residual Approach" section. The formulas are:

Unadjusted Indicated Relativity =

(multiplicative algorithm)

Unadjusted Average Loss / Base Pure Premium [11]

(additive algorithm)

(Unadjusted Average Loss / Base Pure Premium) - 1 [12]

For a multiplicative factor, the *adjusted* indicated relativity is computed by dividing the unadjusted indicated relativity by the PRFPF. For an additive factor, the adjusted indicated relativity is computed by subtracting the PRFPF from the unadjusted indicated relativity.

(for the Prior Relativities Method):
Adjusted Indicated Relativity =
(multiplicative algorithm)
Unadjusted Indicated Relativity / average PRFPF [13]

(additive algorithm)
(Unadjusted Indicated relativity - average PRFPF) [14]

In the first pass through the data the unadjusted average loss is calculated for all categories of all the rating factors. The unadjusted average loss is then converted to an unadjusted indicated relativity. During the first pass there are no prior factors and the PRFPF is 1.0 for multiplicative factors and 0.0 for additive factors. The adjusted indicated relativity for the category is its unadjusted relativity divided by the PRFPF (for multiplicative algorithms) or the unadjusted relativity minus the PRFPF (for additive algorithms).

In the second pass through the data the PRFPF is computed for each vehicle using just the adjusted indicated relativities of the *first* factor. The average PRFPF is then computed for each category of the second factor. The adjusted indicated relativities are calculated following the same procedure used for the first factor.

In the third pass through the data the PRFPF is computed for each vehicle using just the adjusted indicated relativities of the first *two* factors. The average PRFPF is then computed for each category of the third factor. The adjusted indicated relativities are calculated following the same procedure used for the first factor.

If there were additional rating factors in the premium algorithm this process of passing through the data, computing the PRFPF, calculating the average PRFPF for the new factor's categories, and the adjusted indicated relativities would be repeated for each subsequent factor.

Figure 3 shows the results of these procedures applied to the sample data. Note how the adjusted indicated relativities are identical with those produced by the loss residual approach (shown in Figure 2).

Figure 3. Sequential Analysis via the Prior Relativities Method

A. Multiplicative Algorithm: Premium = Base pure premium * F_1 * F_2 * F_3

	Categories	Unadjusted Average Loss	Unadjusted Indicated relativity	Average PRFPF	Adjusted Indicated Relativity
Pass 1.					
Safety	0	149.28	0.96	1.00	0.96
Record	1	183.79	1.19	1.00	1.19
	2+	213.58	1.38	1.00	1.38
	average	155.05	1.00	1.00	1.00
Pass 2.					
Mileage	low	133.35	0.86	0.99	0.87
	medium	150.24	0.97	1.00	0.97
	high	207.76	1.34	1.01	1.33
	average	155.05	1.00	1.00	1.00
Pass 3.					
Years	0 - 7	248.17	1.60	1.03	1.55
Licensed	8 - 14	159.72	1.03	1.03	1.00
	15 +	135.63	0.87	0.99	0.89
	average	155.05	1.00	1.00	1.00

B. Additive Algorithm: Premium = Base pure premium * $(1.0 + F_1 + F_2 + F_3)$

	Categories	Unadjusted Average Loss	Unadjusted Indicated relativity	Average PRFPF	Adjusted Indicated Relativity
Pass 1.					
Safety	0	149.28	-0.04	0.00	-0.04
Record	1	183.79	0.19	0.00	0.19
	2+	213.58	0.38	0.00	0.38
	average	155.05	0.00	0.00	0.00
Pass 2.					
Mileage	low	133.35	-0.14	-0.01	-0.13
	medium	150.24	-0.03	0.00	-0.03
	high	207.76	0.34	0.01	0.33
	average	155.05	0.00	0.00	0.00
Pass 3.					
Years	0 - 7	248.17	0.60	0.03	0.57
Licensed	8 - 14	159.72	0.03	0.03	0.00
	15 +	135.63	-0.13	-0.01	-0.11
	average	155.05	0.00	0.00	0.00

Note: Due to rounding Unadjusted Indicated Relativity - Average PRFPF may differ slightly from Adjusted Indicated Relativity.

Sequential Analysis Using Summary Data

The primary benefit of performing a sequential analysis with summary data is the reduced use of data processing resources. Developing a spreadsheet model to calculate the influence of the prior factors permits the analysis to be performed with only one pass through the loss data. With the analysis based on individual records, one pass through the data is required for each factor. If 15 rating factors are used in the premium calculation algorithm, 15 passes through the data are required. If the data file is substantial, the time and resources saved by using summary data can also be substantial. A spreadsheet model also facilitates performing a number of different "what if" analyses.

In order to build the spreadsheet model, two types of information are needed: (a) the unadjusted average loss, and (b) the appropriate distribution of exposures. The appropriate distribution of exposures is determined by the type of premium calculation algorithm and is discussed in the section "Data Needed for a Sequential Analysis." The extensive distributional data needed for a multiplicative algorithm is the primary reason that a sequential analysis using summary data is only practical for exclusively additive algorithms or algorithms with at most one or two multiplicative factors. However, for illustrative purposes, we have included a model and an example using a multiplicative algorithm for the three simplified rating factors in the earlier examples. For this simplified example it is necessary to compute the cross distribution of only the three factors. This involves a total of 27 (3 * 3 * 3) cells. If 15 factors were used and each factor had only three categories, then a total of 3^{15} (or 14,384,907) cells would be required. The work involved (as well as the increased possibility for errors) in building a model with so many inputs would most likely greatly exceed the effort needed to make multiple passes through the data.

The spreadsheet models shown in the attachments use the prior relativities approach. The first model shown in Attachment A uses a multiplicative algorithm and the second model shown in Attachment B uses a exclusively additive algorithm. The results of the analyses are summarized in the same format as the previous examples based on individual records, then the detailed calculations needed to compute the average PRFPF are shown. One view of these models shows the actual results, the other view shows the formulas used to generate the results. As there is only one pass through the data, the labels "Pass 1, Pass 2, Pass 3" have been replaced with the labels "Step 1, Step 2, Step 3."

The models shown in Attachments A and B produces identical results to the analyses based on individual records (shown in Figures 2 and 3).

II. GDD Accounted for in Factor Development

In this section the GDD is taken into consideration while the rating factors are developed. Setting the relativities for the GDD is considered the initial step in these procedures. In these examples, the election is made to implement the GDD at the minimum requirement of 20%. The summary tables show the step where the GDD relativities are determined. The basic format of section II follows that of section I. For the sake of completeness, some portions of section I are repeated. Overall, most of the differences occur in the additive model. The basic process for the multiplicative model is highly similar to those described in section I.

Loss Residuals Approach

The basic approach used with loss residuals is the same as described in section I. The key difference is in the calculation of the PPBOPF. In this section the effect of the GDD is considered in the formulas. This approach uses two key items of information for each category of the factor being analyzed: (a) the average pure premium based on prior factors (PPBOPF) and (b) the unadjusted average loss. Subtracting the average PPBOPF from the average unadjusted loss gives the loss residual.

$$\text{Loss Residual} = \text{Unadjusted Average Loss} - \text{Average PPBOPF} \qquad [15]$$

The unadjusted average loss is a summary of the losses associated with each category of the factor. It is computed by summing the losses associated with a category and dividing by the number of exposures and contains no adjustments for any other rating factors.

$$\text{Unadjusted Average Loss} = \Sigma_{cat.} \text{ Losses} / \Sigma_{cat.} \text{ Exposures} \qquad [16]$$

For a multiplicative factor the *adjusted* indicated relativity is 1.0 plus the loss residual divided by the average PPBOPF (see formula [19]), where the base pure premium is the average pure premium for all vehicles. For additive factors the adjusted indicated relativity is the loss residual divided by the Base Pure Premium (see formula [20]). The number of factors used in the formula for PPBOPF depends on which step of the sequential analysis is being performed. All factors prior to the factor being developed are included. The general formula for the PPBOPF of the i^{th} rating factor is calculated by the following formulas:

$$\text{PPBOPF} = \quad \text{(multiplicative algorithm)}$$
$$\text{Base Pure Premium} * F_1 * F_2 * F_3 * \ldots * F_{i-1} * \text{GDD} \qquad [17]$$

$$\text{(additive algorithm)}$$
$$\text{Base Pure Premium} * \text{GDD} + (\text{Base Pure Premium} * (F_{1 \times GDD} + F_{2 \times GDD} + F_{3 \times GDD} + \ldots + F_{i-1 \times GDD})) \qquad [18]$$

Where,

F_1 = Adjusted Indicated Relativity for the first factor
F_2 = Adjusted Indicated Relativity for the second factor
F_3 = Adjusted Indicated Relativity for the third factor
$F_{1 \times GDD}$ = Adjusted Indicated Relativity of the hybrid factor combining the first factor and the GDD
$F_{2 \times GDD}$ = Adjusted Indicated Relativity of the hybrid factor combining the second factor and the GDD
$F_{3 \times GDD}$ = Adjusted Indicated Relativity of the hybrid factor combining the third factor and the GDD

(for the Loss Residual Method):

Adjusted Indicated Relativity = (multiplicative algorithm)

$$1.0 + (\text{Loss Residual} / \text{average PPBOPF}) \quad [19]$$

(additive algorithm)

$$= (\text{Loss Residual} / \text{Base Pure Premium}) \quad [20]$$

$$\text{Base Pure Premium} = \Sigma_{all} \text{ Losses} / \Sigma_{all} \text{ Exposures} \quad [21]$$

The formula for the PPBOPF for the additive algorithm (equation [18]) uses a different structure than equation [17]. Also, equation [18] makes use of "hybrid" factors. A key difference between a multiplicative and an additive algorithm is the inclusion of factor interactions in the former and their exclusion from the latter[5]. However, the additive model used in this paper is not exclusively additive since it contains a multiplicative GDD factor. The inclusion of the multiplicative GDD factor introduces factor interactions (with the GDD) that must be controlled to minimize bias. The source of the potential bias, which if large enough may lead to excessive or inadequate premiums, is the varying distribution of GDD among the categories of the other factors. If the GDD was identically distributed among all categories of all factors (a virtual impossibility), no adjustment would be necessary. As this is not the case, the interaction is controlled for by the development of hybrid factors that combine GDD and the factor and the use of equation [18] to compute the PPBOPF for the additive algorithm. The general form of the hybrid factor is to have twice the number of categories of the original factor. One set of categories are restricted to those not qualified for the GDD, and the other set of categories are restricted to those who are qualified for the GDD. For example, the hybrid version of the first factor becomes:

$F_{1 \times GDD}$ = Safety Record x GDD =
- no GDD / 0 points
- no GDD / 1 point
- no GDD / 2 or more points
- yes GDD / 0 points
- yes GDD / 1 point
- yes GDD / 2 or more points

The relativities for the categories of the hybrid factor are set to maintain the GDD requirement. First the adjusted indicated relativities for the original (non-hybrid) factor are computed, then the relativities of the hybrid factor are calculated based on a modification of equation [1]. Assuming that the GDD was being implemented at the minimum requirement of 20%, the formula for computing the relativities of the categories for the hybrid factor would be[6]:

$$y_i = R_i / (1 - (0.2 * x_i)) \quad [22]$$

---

[5]The differences between multiplicative and additive algorithms is discussed further in Hunstad, *et.al.* Impact Analysis of Weighting Auto Rating Factors to Comply with Proposition 103, 1994, p12-15. The appropriateness of including factor interactions depends upon one's belief of the theoretical relationship between the factors and how well the different algorithm fit the loss distributions.

[6]See footnote 3 for using a GDD other than 20%.

where,

y_i = the relativity for vehicles not qualified for a GDD for the i^{th} category of the original (non-hybrid) factor

$0.8 * y_i$ = the relativity for vehicles who are qualified for a GDD for the i^{th} category of the original (non-hybrid) factor

x_i = the percent of vehicles in the i^{th} category that qualify for the GDD expressed as a decimal

In the first pass through the data the unadjusted average loss is calculated for all categories of all the rating factors. Also, the percent of vehicles qualifying for the GDD are calculated. This permits determining the relativities for the GDD. In the second pass there are no prior factors (except for the GDD) and the PPBOPF for the categories of the first factor is simply the base pure premium times the GDD factor (where the base pure premium is the average loss for all vehicles). The loss residual (formula [15]) for each category of the first factor is its unadjusted average loss minus the average PPBOPF. The adjusted indicated relativity for the category is 1.0 plus the loss residual divided by the base pure premium (formula [19] for multiplicative algorithms) or the loss residual divided by the base pure premium (formula [20] for additive algorithms).

In the third pass through the data the PPBOPF is computed for each vehicle using the base pure premium, the GDD, and the indicated relativities of the *first* factor (or the hybrid version of the first factor if the additive algorithm is used). The average PPBOPF is then computed for each category of the second factor. The loss residual is computed by subtracting the average PPBOPF from the unadjusted average loss. The adjusted indicated relativities are calculated following the same procedure used for the first factor.

In the fourth pass through the data the PPBOPF is computed for each vehicle using the base pure premium, the GDD, and the indicated relativities of the first *two* rating factors (or the hybrid version of the first two factors if the additive algorithm is used). The average PPBOPF is then computed for each category of the third factor. The loss residual is computed by subtracting the average PPBOPF from the unadjusted average loss. The adjusted indicated relativities are calculated following the same procedure used for the first factor.

If there were additional rating factors in the premium algorithm this process of passing through the data, computing a PPBOPF, calculating the average PPBOPF for the new factor's categories, computing the loss residual, and finally the adjusted indicated relativities would be repeated for each subsequent factor.

Figure 4 shows the results of these procedures applied to the sample data. It is interesting to note how the resulting indicated relativities for the two different types of algorithms are fairly similar. However, in pass 4 a slight difference can be noted in the average PPBOPF. This difference is due to the interaction effects included in the multiplicative algorithm and not included in the additive algorithm. Depending on the underlying distribution of exposures and as more factors are added to the algorithms, the potential for differences between the multiplicative and additive

approaches increase.

In the second pass through the data the interaction between the GDD and the Safety Record can be seen. Moving from 1 point to 2+ points is a key threshold for qualifying for the GDD. This can be clearly seen in the average PPBOPF for these categories. Had an algorithm been used that did not have a separate GDD factor, the average PPBOPF for all categories of the first factor would have all been the same (the base pure premium). Also, the relativity for the 2+ points category is quite different depending on the algorithm. This is due to the effect of the GDD being taken into consideration in the multiplicative algorithm. The difference in the relativities of the 2+ points categories is reduced when the hybrid factor of safety record and GDD is created for use in the additive algorithm. (These hybrid relativities are shown in Attachment D.)

Figure 4. Sequential Analysis via the Loss Residual Method
A. Multiplicative Algorithm: Premium = Base pure premium * F_1 * F_2 * F_3 * GDD

	Categories	Average PPBOPF	Unadjusted Average Loss	Loss Residual	Adjusted Indicated Relativity
Pass 1.					
GDD	no	155.05	289.00	133.94	1.23
	yes	155.05	145.52	-9.54	0.98
	average	155.05	155.05	0.00	1.00
Pass 2.					
Safety	0	154.36	149.28	-5.08	0.97
Record	1	154.77	183.79	29.02	1.19
	2+	183.27	213.58	30.31	1.17
	average	155.05	155.05	0.00	1.00
Pass 3.					
Mileage	low	152.93	133.35	-19.59	0.87
	medium	155.36	150.24	-5.12	0.97
	high	156.03	207.76	51.73	1.33
	average	155.05	155.05	0.00	1.00
Pass 4.					
Years	0 - 7	171.37	248.17	76.80	1.45
Licensed	8 - 14	158.17	159.72	1.55	1.01
	15 +	151.15	135.63	-15.51	0.90
	average	155.05	155.05	0.00	1.00

Figure 4 (continued)
B. Additive Algorithm: Premium = Base pure premium * $(1.0 + F_1 + F_2 + F_3)$ * GDD

	Categories	Average PPBOPF	Unadjusted Average Loss	Loss Residual	Adjusted Indicated Relativity
Pass 1.					
GDD	no	155.05	289.00	133.94	1.23
	yes	155.05	145.52	-9.54	0.98
	average	155.05	155.05	0.00	1.00
Pass 2.					
Safety	0	154.36	149.28	-5.08	-0.03
Record	1	154.77	183.79	29.02	0.19
	2+	183.27	213.58	30.31	0.20
	average	155.05	155.05	0.00	0.00
Pass 3.					
Mileage	low	152.93	133.35	-19.59	-0.13
	medium	155.36	150.24	-5.12	-0.03
	high	156.03	207.76	51.73	0.33
	average	155.05	155.05	0.00	0.00
Pass 4.					
Years	0 - 7	171.36	248.17	76.80	0.50
Licensed	8 - 14	158.18	159.72	1.54	0.01
	15 +	151.14	135.63	-15.51	-0.10
	average	155.05	155.05	0.00	0.00

Note: Adjusted indicated relativities for GDD are set so as to provide the required 20% difference. Loss residuals may be effected by rounding. For the additive algorithm, the hybrid factors and their relativities are shown in Attachment D.

Prior Relativities Approach

In the prior relativities approach the focus is on the impact of the relativities from prior factors. The two key items of information are: (a) the average prior relativities from prior factors (PRFPF) and (b) the unadjusted indicated relativity. The PRFPF is computed using relativities of prior factors. The formulas for the i^{th} rating factor are:

PRFPF = (multiplicative algorithm)

$$F_1 * F_2 * F_3 * \ldots * F_{i-1} * GDD \qquad [23]$$

(additive algorithm)

$$(F_{1 \times GDD} + F_{2 \times GDD} + F_{3 \times GDD} + \ldots + F_{i-1 \times GDD}) + (GDD - 1) \qquad [24]$$

The discussion of the hybrid factors in the previous section on the loss residual approach is also

applicable to the prior relativities approach. A similar approach of creating hybrid factors is required in the additive algorithm to control for factor interactions with the GDD. A detailed example illustrating these calculations is shown in Attachment D.

The unadjusted indicated relativity is based on the unadjusted average loss that is computed as described in formula [16] in the "Loss Residual Approach" section. The formulas are:

Unadjusted Indicated Relativity =

(multiplicative algorithm)

Unadjusted Average Loss / Base Pure Premium [25]

(additive algorithm)

(Unadjusted Average Loss / Base Pure Premium) - 1 [26]

For a multiplicative factor, the *adjusted* indicated relativity is computed by dividing the unadjusted indicated relativity by the PRFPF. For an additive factor, the adjusted indicated relativity is computed by subtracting the PRFPF from the unadjusted indicated relativity.

(for the Prior Relativities Method):

Adjusted Indicated Relativity =

(multiplicative algorithm)

Unadjusted Indicated Relativity / average PRFPF [27]

(additive algorithm)

(Unadjusted Indicated relativity - average PRFPF) [28]

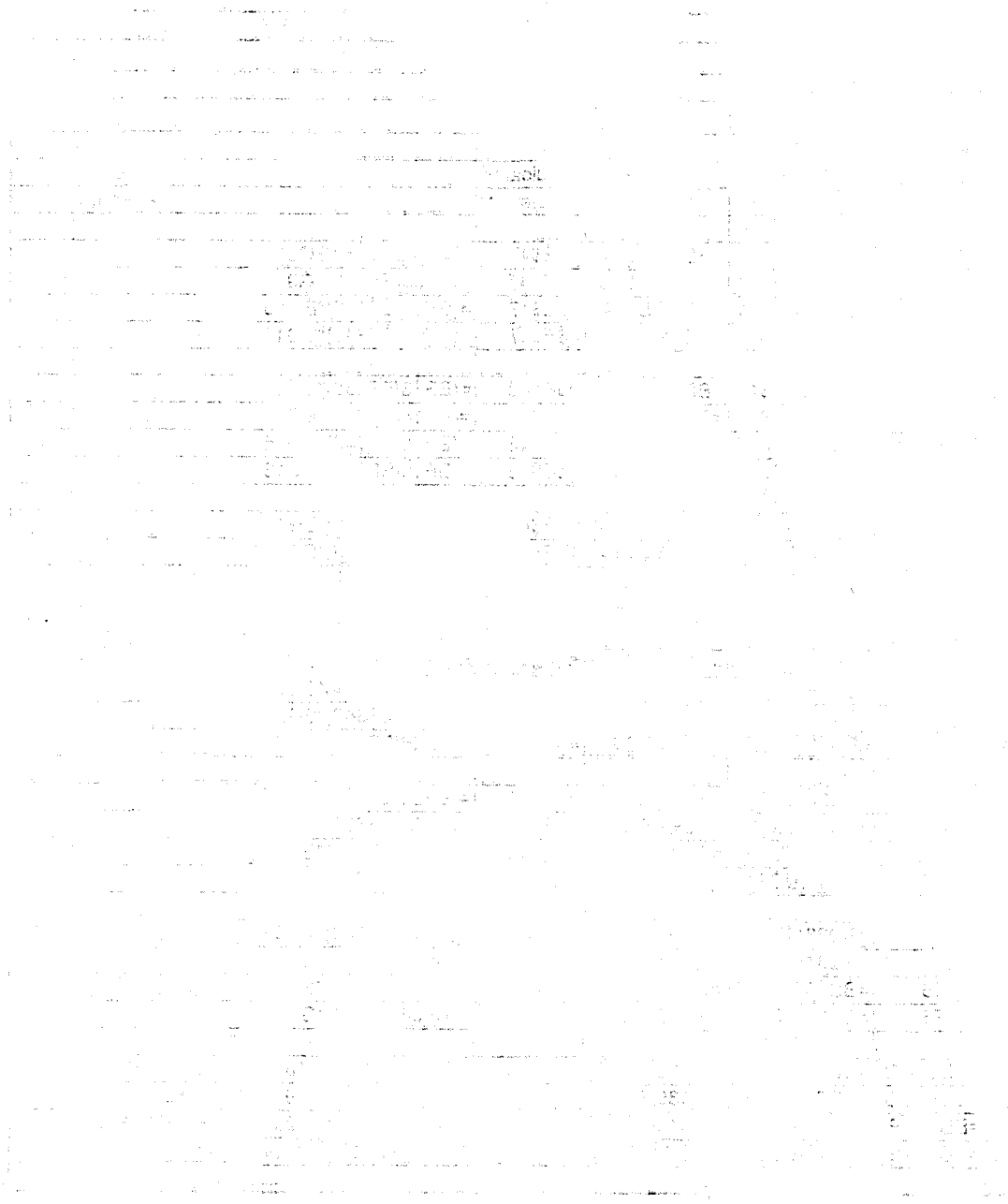
In the first pass through the data the unadjusted average loss is calculated for all categories of all the rating factors. The unadjusted average loss is then converted to an unadjusted indicated relativity. Also, the percent of vehicles qualifying for the GDD are calculated. This permits determining the relativities for the GDD. In the second pass there are no prior factors (except the GDD) and the PRFPF is only influenced by the GDD requirement. The adjusted indicated relativity for the category is its unadjusted relativity divided by the PRFPF (for multiplicative algorithms) or the unadjusted relativity minus the PRFPF (for additive algorithms).

In the third pass through the data the PRFPF is computed for each vehicle using just the adjusted indicated relativities of the GDD and the *first* factor (or the hybrid version of the first factor if the additive algorithm is used). The average PRFPF is then computed for each category of the second factor. The adjusted indicated relativities are calculated following the same procedure used for the first factor.

In the fourth pass through the data the PRFPF is computed for each vehicle using just the adjusted indicated relativities of the GDD and the first *two* factors (or the hybrid version of the first two factor if the additive algorithm is used). The average PRFPF is then computed for each category of the third factor. The adjusted indicated relativities are calculated following the same procedure used for the first factor.

	BB	BC	BD	BE	BF	BG	BH	BI
1								
2								
3	*Determi*							
4								
5				Exposure		j. Indicated	Part of	
6			#	% of category	% of total	Relativity	Average	
7	GDD x Mile.	Yrs. Lic.						
8	no / low	low	694	=BD8/BD$11	=BD8/BD$41	=$E$47	=(BF8/BF$38)*BG8	
9		med.	30	=BD9/BD$11	=BD9/BD$41	=$E$47	=(BF9/BF$39)*BG9	
10		high	229	=BD10/BD$11	=BD10/BD$41	=$E$47	=(BF10/BF$40)*BG10	
11		average	952	=BD11/BD$11	=BD11/BD$41	=$E$47	=(BF11/BF$41)*BG11	
12								
13	no / med.	low	6155	=BD13/BD$16	=BD13/BD$41	=$E$48	=(BF13/BF$38)*BG13	
14		med.	388	=BD14/BD$16	=BD14/BD$41	=$E$48	=(BF14/BF$39)*BG14	
15		high	1028	=BD15/BD$16	=BD15/BD$41	=$E$48	=(BF15/BF$40)*BG15	
16		average	7571	=BD16/BD$16	=BD16/BD$41	=$E$48	=(BF16/BF$41)*BG16	
17								
18	no / high	low	1099	=BD18/BD$21	=BD18/BD$41	=$E$49	=(BF18/BF$38)*BG18	
19		med.	91	=BD19/BD$21	=BD19/BD$41	=$E$49	=(BF19/BF$39)*BG19	
20		high	190	=BD20/BD$21	=BD20/BD$41	=$E$49	=(BF20/BF$40)*BG20	
21		average	1381	=BD21/BD$21	=BD21/BD$41	=$E$49	=(BF21/BF$41)*BG21	
22								
23	yes / low	low	820	=BD23/BD$26	=BD23/BD$41	=$F$47	=(BF23/BF$38)*BG23	
24		med.	1800	=BD24/BD$26	=BD24/BD$41	=$F$47	=(BF24/BF$39)*BG24	
25		high	20566	=BD25/BD$26	=BD25/BD$41	=$F$47	=(BF25/BF$40)*BG25	
26		average	23185	=BD26/BD$26	=BD26/BD$41	=$F$47	=(BF26/BF$41)*BG26	
27								
28	yes / med.	low	9985	=BD28/BD$31	=BD28/BD$41	=$F$48	=(BF28/BF$38)*BG28	
29		med.	16834	=BD29/BD$31	=BD29/BD$41	=$F$48	=(BF29/BF$39)*BG29	
30		high	70941	=BD30/BD$31	=BD30/BD$41	=$F$48	=(BF30/BF$40)*BG30	
31		average	97759	=BD31/BD$31	=BD31/BD$41	=$F$48	=(BF31/BF$41)*BG31	
32								
33	yes / high	low	2005	=BD33/BD$36	=BD33/BD$41	=$F$49	=(BF33/BF$38)*BG33	
34		med.	4037	=BD34/BD$36	=BD34/BD$41	=$F$49	=(BF34/BF$39)*BG34	
35		high	12136	=BD35/BD$36	=BD35/BD$41	=$F$49	=(BF35/BF$40)*BG35	
36		average	18178	=BD36/BD$36	=BD36/BD$41	=$F$49	=(BF36/BF$41)*BG36	
37								
38	average	low	=BD8+BD	=BD38/BD$41	=BD38/BD$41		=BH8+BH13+BH18+BH23+BH28+BH33	
39		med.	=BD9+BD	=BD39/BD$41	=BD39/BD$41		=BH9+BH14+BH19+BH24+BH29+BH34	
40		high	=BD10+B	=BD40/BD$41	=BD40/BD$41		=BH10+BH15+BH20+BH25+BH30+BH35	
41		average	=BD11+B	=BD41/BD$41	=BD41/BD$41		=BH11+BH16+BH21+BH26+BH31+BH36	
42								

	AS	AT	AU	AV	AW	AX	AY	AZ
1								
2								
3	*Determi*							
4								
5				Exposure		j. Indicated	Part of	
6			#	% of category	% of total	Relativity	Average	
7	GDD x Safe.	Yrs. Lic.						
8	no / 0	low	6136	=AU8/AU$11	=AU8/AU$41	=$E$42	=(AW8/AW$38)*AX8	
9		med.	0	=AU9/AU$11	=AU9/AU$41	=$E$42	=(AW9/AW$39)*AX9	
10		high	0	=AU10/AU$11	=AU10/AU$41	=$E$42	=(AW10/AW$40)*AX10	
11		average	6136	=AU11/AU$11	=AU11/AU$41	=$E$42	=(AW11/AW$41)*AX11	
12								
13	no / 1	low	1107	=AU13/AU$16	=AU13/AU$41	=$E$43	=(AW13/AW$38)*AX13	
14		med.	0	=AU14/AU$16	=AU14/AU$41	=$E$43	=(AW14/AW$39)*AX14	
15		high	0	=AU15/AU$16	=AU15/AU$41	=$E$43	=(AW15/AW$40)*AX15	
16		average	1107	=AU16/AU$16	=AU16/AU$41	=$E$43	=(AW16/AW$41)*AX16	
17								
18	no / 2+	low	706	=AU18/AU$21	=AU18/AU$41	=$E$44	=(AW18/AW$38)*AX18	
19		med.	509	=AU19/AU$21	=AU19/AU$41	=$E$44	=(AW19/AW$39)*AX19	
20		high	1447	=AU20/AU$21	=AU20/AU$41	=$E$44	=(AW20/AW$40)*AX20	
21		average	2662	=AU21/AU$21	=AU21/AU$41	=$E$44	=(AW21/AW$41)*AX21	
22								
23	yes / 0	low	10449	=AU23/AU$26	=AU23/AU$41	=$F$42	=(AW23/AW$38)*AX23	
24		med.	19049	=AU24/AU$26	=AU24/AU$41	=$F$42	=(AW24/AW$39)*AX24	
25		high	91303	=AU25/AU$26	=AU25/AU$41	=$F$42	=(AW25/AW$40)*AX25	
26		average	120801	=AU26/AU$26	=AU26/AU$41	=$F$42	=(AW26/AW$41)*AX26	
27								
28	yes / 1	low	2224	=AU28/AU$31	=AU28/AU$41	=$F$43	=(AW28/AW$38)*AX28	
29		med.	3480	=AU29/AU$31	=AU29/AU$41	=$F$43	=(AW29/AW$39)*AX29	
30		high	11978	=AU30/AU$31	=AU30/AU$41	=$F$43	=(AW30/AW$40)*AX30	
31		average	17681	=AU31/AU$31	=AU31/AU$41	=$F$43	=(AW31/AW$41)*AX31	
32								
33	yes / 2+	low	136	=AU33/AU$36	=AU33/AU$41	=$F$44	=(AW33/AW$38)*AX33	
34		med.	142	=AU34/AU$36	=AU34/AU$41	=$F$44	=(AW34/AW$39)*AX34	
35		high	362	=AU35/AU$36	=AU35/AU$41	=$F$44	=(AW35/AW$40)*AX35	
36		average	639	=AU36/AU$36	=AU36/AU$41	=$F$44	=(AW36/AW$41)*AX36	
37								
38	average	low	=AU8+AU	=AU38/AU$41	=AU38/AU$41		=AY8+AY13+AY18+AY23+AY28+AY33	
39		med.	=AU9+AU	=AU39/AU$41	=AU39/AU$41		=AY9+AY14+AY19+AY24+AY29+AY34	
40		high	=AU10+A	=AU40/AU$41	=AU40/AU$41		=AY10+AY15+AY20+AY25+AY30+AY35	
41		average	=AU11+A	=AU41/AU$41	=AU41/AU$41		=AY11+AY16+AY21+AY26+AY31+AY36	
42								



If there were additional rating factors in the premium algorithm this process of passing through the data, computing the PRFPF, calculating the average PRFPF for the new factor's categories, and the adjusted indicated relativities would be repeated for each subsequent factor.

Figure 5 shows the results of these procedures applied to the sample data. Note how the adjusted indicated relativities are identical with those produced by the loss residual approach (shown in Figure 4).

Figure 5. Sequential Analysis via the Prior Relativities Method
A. Multiplicative Algorithm: Premium = Base pure premium * F_1 * F_2 * F_3 * GDD

	Categories	Unadjusted Average Loss	Unadjusted Indicated Relativity	Average PRFPF	Adjusted Indicated Relativity
Pass 1.					
GDD	no	289.00	1.86	1.00	1.23
	yes	145.52	0.94	1.00	0.98
	average	155.05	1.00	1.00	1.00
Pass 2.					
Safety	0	149.28	0.96	1.00	0.97
Record	1	183.79	1.19	1.00	1.19
	2+	213.58	1.38	1.18	1.17
	average	155.05	1.00	1.00	1.00
Pass 3.					
Mileage	low	133.35	0.86	0.99	0.87
	medium	150.24	0.97	1.00	0.97
	high	207.76	1.34	1.01	1.33
	average	155.05	1.00	1.00	1.00
Pass 4.					
Years	0 - 7	248.17	1.60	1.11	1.45
Licensed	8 - 14	159.72	1.03	1.02	1.01
	15 +	135.63	0.87	0.97	0.90
	average	155.05	1.00	1.00	1.00

Figure 5 (continued)
B. Additive Algorithm: Premium = Base pure premium * $(1.0 + F_1 + F_2 + F_3)$ * GDD

	Categories	Unadjusted Average Loss	Unadjusted Indicated Relativity	Average PRFPF	Adjusted Indicated Relativity
Pass 1.					
GDD	no	289.00	1.86	1.00	1.23
	yes	145.52	0.94	1.00	0.98
	average	155.05	1.00	1.00	1.00
Pass 2.					
Safety	0	149.28	-0.04	-0.00	-0.03
Record	1	183.79	0.19	-0.00	0.19
	2+	213.58	0.38	0.18	0.20
	average	155.05	0.00	0.00	0.00
Pass 3.					
Mileage	low	133.35	-0.14	-0.01	-0.13
	medium	150.24	-0.03	0.00	-0.03
	high	207.76	0.34	0.01	0.33
	average	155.05	0.00	0.00	0.00
Pass 4.					
Years	0 - 7	248.17	0.60	0.11	0.50
Licensed	8 - 14	159.72	0.03	0.02	0.01
	15 +	135.63	-0.13	-0.03	-0.10
	average	155.05	0.00	0.00	0.00

Note: Due to rounding Unadjusted Indicated Relativity - Average PRFPF may differ slightly from Adjusted Indicated Relativity. Adjusted indicated relativities for GDD are set so as to provide the required 20% difference. For the additive algorithm, the hybrid factors and their relativities are shown in Attachment D.

Sequential Analysis Using Summary Data

The discussion of sequential analysis using summary data in section I is equally applicable to the use of summary data when the effect of the GDD is being considered in the development of the rating factors. The multiplicative and additive models using summary data and incorporating the effect of GDD are shown in Attachments C and D.

Attachment A

Sequential Analysis Using Summary Data and Multiplicative Algorithm

	A	B	C	D	E	F	G	H
1	A. Sequential Analysis Using Summary Data and Prior Relativities Approach							
2	Multiplicative Model: Premium = Base Rate * F1 * F2 * F3							
3								
4								
5			Unadjusted	Unadjusted	Average	Adjusted		
6		Categories	Average Loss	Indicated Relativity	PRFPF	Indicated Relativity		
7								
8	Step 1.							
9	Safety	0	149.28	0.9628	1.0000	0.9628		
10	Record	1	183.79	1.1853	1.0000	1.1853		
11		2+	213.58	1.3774	1.0000	1.3774		
12		average	155.05	1.0000	1.0000	1.0000		
13								
14	Step 2.							
15	Mileage	low	133.35	0.8600	0.9916	0.8673		
16		medium	150.24	0.9690	1.0008	0.9682		
17		high	207.76	1.3399	1.0060	1.3320		
18		average	155.05	1.0000	1.0000	1.0000		
19								
20	Step 3.							
21	Years	0 - 7	248.17	1.6005	1.0310	1.5524		
22	Licensed	8 - 14	159.72	1.0301	1.0331	0.9970		
23		15 +	135.63	0.8748	0.9866	0.8867		
24		average	155.05	1.0000	1.0000	1.0000		
25								
26								
27	NOTE: Adjusted Indicated Relativities for GDD set so as to provide the required 20% difference.							
28								
29								
30								
31								
32								
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3	*Determining prior relativities for Mileage*								
4									
5			Exposure			Prior	Part of		
6			#	% of category	% of total	Relativities	Average		
7	Safety Factor:	**Mileage:**							
8	0	low	21330	16.804%	14.313%	0.9628	0.8508		
9		medium	89420	70.444%	60.003%	0.9628	0.8173		
10		high	16187	12.752%	10.862%	0.9628	0.7968		
11		average	126937	100.000%	85.178%	0.9628	0.8201		
12									
13	1	low	2443	13.004%	1.639%	1.1853	0.1200		
14		medium	13468	71.688%	9.037%	1.1853	0.1516		
15		high	2877	15.314%	1.931%	1.1853	0.1744		
16		average	18787	100.000%	12.607%	1.1853	0.1494		
17									
18	2+	low	365	11.057%	0.245%	1.3774	0.0208		
19		medium	2442	73.978%	1.639%	1.3774	0.0319		
20		high	494	14.965%	0.331%	1.3774	0.0348		
21		average	3301	100.000%	2.215%	1.3774	0.0305		
22									
23									
24	average	low	24138	16.197%	16.197%		0.9916		
25		medium	105330	70.679%	70.679%		1.0008		
26		high	19558	13.124%	13.124%		1.0060		
27		average	149025	100.000%	100.000%		1.0000		
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2									
3	*Determining prior relativities for Years Licensed*								
4									
5				Exposure			Prior	Part of	
6				#	% of category	% of total	Relativities	Average	
7	Safety Factor:	Mileage:	Yrs. Lic.:						
8	0	low	0 - 7	1258	5.898%	0.844%	0.8350	0.0506	
9			8 - 14	1562	7.323%	1.048%	0.8350	0.0563	
10			15 +	18509	86.774%	12.420%	0.8350	0.1471	
11			average	21330	100.000%	14.313%	0.8350	0.1195	
12									
13		medium	0 - 7	12882	14.406%	8.644%	0.9321	0.5785	
14			8 - 14	14116	15.786%	9.472%	0.9321	0.5677	
15			15 +	62422	69.808%	41.887%	0.9321	0.5537	
16			average	89420	100.000%	60.003%	0.9321	0.5593	
17									
18		high	0 - 7	2444	15.099%	1.640%	1.2823	0.1510	
19			8 - 14	3371	20.825%	2.262%	1.2823	0.1865	
20			15 +	10372	64.076%	6.960%	1.2823	0.1266	
21			average	16187	100.000%	10.862%	1.2823	0.1393	
22									
23	1	low	0 - 7	201	8.228%	0.135%	1.0280	0.0100	
24			8 - 14	233	9.537%	0.156%	1.0280	0.0103	
25			15 +	2009	82.235%	1.348%	1.0280	0.0197	
26			average	2443	100.000%	1.639%	1.0280	0.0169	
27									
28		medium	0 - 7	2604	19.335%	1.747%	1.1476	0.1440	
29			8 - 14	2603	19.327%	1.747%	1.1476	0.1289	
30			15 +	8262	61.345%	5.544%	1.1476	0.0902	
31			average	13468	100.000%	9.037%	1.1476	0.1037	
32									
33		high	0 - 7	526	18.283%	0.353%	1.5788	0.0400	
34			8 - 14	644	22.384%	0.432%	1.5788	0.0439	
35			15 +	1708	59.367%	1.146%	1.5788	0.0257	
36			average	2877	100.000%	1.931%	1.5788	0.0305	
37									
38	2+	low	0 - 7	54	14.795%	0.036%	1.1947	0.0031	
39			8 - 14	34	9.315%	0.023%	1.1947	0.0018	
40			15 +	277	75.890%	0.186%	1.1947	0.0031	
41			average	365	100.000%	0.245%	1.1947	0.0029	
42									
43		medium	0 - 7	654	26.781%	0.439%	1.3336	0.0420	
44			8 - 14	503	20.598%	0.338%	1.3336	0.0289	
45			15 +	1285	52.621%	0.862%	1.3336	0.0163	
46			average	2442	100.000%	1.639%	1.3336	0.0219	
47									
48		high	0 - 7	134	27.126%	0.090%	1.8347	0.0118	
49			8 - 14	113	22.874%	0.076%	1.8347	0.0089	
50			15 +	247	50.000%	0.166%	1.8347	0.0043	
51			average	494	100.000%	0.331%	1.8347	0.0061	
52									
53	average	average	0 - 7	20757	13.928%	13.928%		1.0310	
54			8 - 14	23179	15.554%	15.554%		1.0331	
55			15 +	105091	70.519%	70.519%		0.9866	
56			average	149026	100.000%	100.000%		1.0000	
57									

	A	B	C	D	E	F
1	A. Sequential An					
2	Multiplicative Model:					
3						
4						
5			Unadjusted	Unadjusted	Average	Adjusted
6		Categories	Average Loss	Indicated Relativity	PRFPF	Indicated Relativity
7						
8	Step 1.					
9	Safety	0	149.280347	=C9/$C$12	1	=D9/E9
10	Record	1	183.785927	=C10/$C$12	1	=D10/E10
11		2+	213.576692	=C11/$C$12	1	=D11/E11
12		average	155.054756	=C12/$C$12	1	=D12/E12
13						
14	Step 2.					
15	Mileage	low	133.345152	=C15/$C$18	=O24	=D15/E15
16		medium	150.2434	=C16/$C$18	=O25	=D16/E16
17		high	207.758208	=C17/$C$18	=O26	=D17/E17
18		average	155.054756	=C18/$C$18	=O27	=D18/E18
19						
20	Step 3.					
21	Years	0 - 7	248.167142	=C21/$C$24	=Y53	=D21/E21
22	Licensed	8 - 14	159.71851	=C22/$C$24	=Y54	=D22/E22
23		15 +	135.634746	=C23/$C$24	=Y55	=D23/E23
24		average	155.054756	=C24/$C$24	=Y56	=D24/E24
25						
26						
27	NOTE: Adjusted Ind					
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3	*Deter*							
4								
5			Exposure			Prior	Part of	
6			#	% of category	% of total	Relativities	Average	
7	ty Factor:	Mileage:						
8	0	low	21330	=K8/K11	=K8/K$27	=$F$9	=(M8/M$24)*N8	
9		medium	89420	=K9/K11	=K9/K$27	=$F$9	=(M9/M$25)*N9	
10		high	16187	=K10/K11	=K10/K$27	=$F$9	=(M10/M$26)*N10	
11		average	126937	=K11/K11	=K11/K$27	=$F$9	=(M11/M$27)*N11	
12								
13	1	low	2443	=K13/K16	=K13/K$27	=$F$10	=(M13/M$24)*N13	
14		medium	13468	=K14/K16	=K14/K$27	=$F$10	=(M14/M$25)*N14	
15		high	2877	=K15/K16	=K15/K$27	=$F$10	=(M15/M$26)*N15	
16		average	18787	=K16/K16	=K16/K$27	=$F$10	=(M16/M$27)*N16	
17								
18	2+	low	365	=K18/K21	=K18/K$27	=$F$11	=(M18/M$24)*N18	
19		medium	2442	=K19/K21	=K19/K$27	=$F$11	=(M19/M$25)*N19	
20		high	494	=K20/K21	=K20/K$27	=$F$11	=(M20/M$26)*N20	
21		average	3301	=K21/K21	=K21/K$27	=$F$11	=(M21/M$27)*N21	
22								
23								
24	average	low	=SUM(K8,K13,K18)	=K24/K27	=SUM(M8,M13,M18)		=SUM(O8,O13,O18)	
25		medium	=SUM(K9,K14,K19)	=K25/K27	=SUM(M9,M14,M19)		=SUM(O9,O14,O19)	
26		high	=SUM(K10,K15,K20)	=K26/K27	=SUM(M10,M15,M20)		=SUM(O10,O15,O20)	
27		average	=SUM(K11,K16,K21)	=K27/K27	=SUM(M11,M16,M21)		=SUM(O11,O16,O21)	
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3	*Deter*								
4									
5				Exposure			Prior	Part of	
6				#	% of category	% of total	Relativities	Average	
7	ty Factor:	Mileage:	rs. Lic.:						
8	0	low	0 - 7	1258	=U8/U11	=U8/$U$56	=$F$9*$F$15	=(W8/$W$53)*X8	
9			8 - 14	1562	=U9/U11	=U9/$U$56	=$F$9*$F$15	=(W9/$W$54)*X9	
10			15 +	18509	=U10/U11	=U10/$U$56	=$F$9*$F$15	=(W10/$W$55)*X10	
11			average	21330	=U11/U11	=U11/$U$56	=$F$9*$F$15	=(W11/$W$56)*X11	
12									
13		medium	0 - 7	12882	=U13/U16	=U13/$U$56	=$F$9*$F$16	=(W13/$W$53)*X13	
14			8 - 14	14116	=U14/U16	=U14/$U$56	=$F$9*$F$16	=(W14/$W$54)*X14	
15			15 +	62422	=U15/U16	=U15/$U$56	=$F$9*$F$16	=(W15/$W$55)*X15	
16			average	89420	=U16/U16	=U16/$U$56	=$F$9*$F$16	=(W16/$W$56)*X16	
17									
18		high	0 - 7	2444	=U18/U21	=U18/$U$56	=$F$9*$F$17	=(W18/$W$53)*X18	
19			8 - 14	3371	=U19/U21	=U19/$U$56	=$F$9*$F$17	=(W19/$W$54)*X19	
20			15 +	10372	=U20/U21	=U20/$U$56	=$F$9*$F$17	=(W20/$W$55)*X20	
21			average	16187	=U21/U21	=U21/$U$56	=$F$9*$F$17	=(W21/$W$56)*X21	
22									
23	1	low	0 - 7	201	=U23/U26	=U23/$U$56	=$F$10*$F$15	=(W23/$W$53)*X23	
24			8 - 14	233	=U24/U26	=U24/$U$56	=$F$10*$F$15	=(W24/$W$54)*X24	
25			15 +	2009	=U25/U26	=U25/$U$56	=$F$10*$F$15	=(W25/$W$55)*X25	
26			average	2443	=U26/U26	=U26/$U$56	=$F$10*$F$15	=(W26/$W$56)*X26	
27									
28		medium	0 - 7	2604	=U28/U31	=U28/$U$56	=$F$10*$F$16	=(W28/$W$53)*X28	
29			8 - 14	2603	=U29/U31	=U29/$U$56	=$F$10*$F$16	=(W29/$W$54)*X29	
30			15 +	8262	=U30/U31	=U30/$U$56	=$F$10*$F$16	=(W30/$W$55)*X30	
31			average	13468	=U31/U31	=U31/$U$56	=$F$10*$F$16	=(W31/$W$56)*X31	
32									
33		high	0 - 7	526	=U33/U36	=U33/$U$56	=$F$10*$F$17	=(W33/$W$53)*X33	
34			8 - 14	644	=U34/U36	=U34/$U$56	=$F$10*$F$17	=(W34/$W$54)*X34	
35			15 +	1708	=U35/U36	=U35/$U$56	=$F$10*$F$17	=(W35/$W$55)*X35	
36			average	2877	=U36/U36	=U36/$U$56	=$F$10*$F$17	=(W36/$W$56)*X36	
37									
38	2+	low	0 - 7	54	=U38/U41	=U38/$U$56	=$F$11*$F$15	=(W38/$W$53)*X38	
39			8 - 14	34	=U39/U41	=U39/$U$56	=$F$11*$F$15	=(W39/$W$54)*X39	
40			15 +	277	=U40/U41	=U40/$U$56	=$F$11*$F$15	=(W40/$W$55)*X40	
41			average	365	=U41/U41	=U41/$U$56	=$F$11*$F$15	=(W41/$W$56)*X41	
42									
43		medium	0 - 7	654	=U43/U46	=U43/$U$56	=$F$11*$F$16	=(W43/$W$53)*X43	
44			8 - 14	503	=U44/U46	=U44/$U$56	=$F$11*$F$16	=(W44/$W$54)*X44	
45			15 +	1285	=U45/U46	=U45/$U$56	=$F$11*$F$16	=(W45/$W$55)*X45	
46			average	2442	=U46/U46	=U46/$U$56	=$F$11*$F$16	=(W46/$W$56)*X46	
47									
48		high	0 - 7	134	=U48/U51	=U48/$U$56	=$F$11*$F$17	=(W48/$W$53)*X48	
49			8 - 14	113	=U49/U51	=U49/$U$56	=$F$11*$F$17	=(W49/$W$54)*X49	
50			15 +	247	=U50/U51	=U50/$U$56	=$F$11*$F$17	=(W50/$W$55)*X50	
51			average	494	=U51/U51	=U51/$U$56	=$F$11*$F$17	=(W51/$W$56)*X51	
52									
53	average	average	0 - 7	=SUM(U8,U1	=U53/U56	=U53/$U$56		=SUM(Y8,Y13,Y18,Y23,Y28,Y33,Y38,Y43,Y48)	
54			8 - 14	=SUM(U9,U1	=U54/U56	=U54/$U$56		=SUM(Y9,Y14,Y19,Y24,Y29,Y34,Y39,Y44,Y49)	
55			15 +	=SUM(U10,U	=U55/U56	=U55/$U$56		=SUM(Y10 Y15,Y20,Y25,Y30,Y35,Y40,Y45,Y50)	
56			average	=SUM(U11,U	=U56/U56	=U56/$U$56		=SUM(Y11 Y16,Y21,Y26,Y31,Y36,Y41,Y46,Y51)	
57									

Attachment B

Sequential Analysis Using Summary Data and a Exclusively Additive Algorithm

	A	B	C	D	E	F	G
1	C. Sequential Analysis Using Summary Data and Prior Relativities Approach						
2	Additive Model: Premium = Base Rate * (1.0 + F1 + F2 + F3)						
3							
4							
5			Unadjusted	Unadjusted	Average	Adjusted	
6		Categories	Average Loss	Indicated Relativity	PRFPF	Indicated Relativity	
7	Step 1.						
8	Safety	0	$149.28	-0.0372	0.0000	-0.0372	
9	Record	1	$183.79	0.1853	0.0000	0.1853	
10		2	$213.58	0.3774	0.0000	0.3774	
11		average	$155.05	0.0000	0.0000	0.0000	
12	Step 2.						
13	Mileage	low	$133.35	-0.1400	-0.0084	-0.1316	
14		medium	$150.24	-0.0310	0.0008	-0.0319	
15		high	$207.76	0.3399	0.0060	0.3339	
16		average	$155.05	0.0000	0.0000	0.0000	
17							
18	Step 3.						
19	Years						
20	Licensed	0 - 7	$248.17	0.6005	0.0309	0.5697	
21		8 - 14	$159.72	0.0301	0.0332	-0.0032	
22		15 +	$135.63	-0.1252	-0.0134	-0.1118	
23		average	$155.05	0.0000	0.0000	0.0000	
24							
25							
26							
27							
28							

	H	I	J	K	L	M	N	O	P	Q
1										
2										
3		*Determining prior relativities for Mileage*								
4										
5				Exposure			Prior	Part of		
6				#	% of category	% of total	Relative	Average		
7		Safety Record	**Mileage**							
8		0	low	21330	16.804%	14.313%	-0.0372	-0.0329		
9			medium	89420	70.444%	60.003%	-0.0372	-0.0316		
10			high	16187	12.752%	10.862%	-0.0372	-0.0308		
11			average	126937	100.000%	85.178%	-0.0372	-0.0317		
12										
13		1	low	2443	13.004%	1.639%	0.1853	0.0188		
14			medium	13468	71.688%	9.037%	0.1853	0.0237		
15			high	2877	15.314%	1.931%	0.1853	0.0273		
16			average	18787	100.000%	12.607%	0.1853	0.0234		
17										
18		2+	low	365	11.057%	0.245%	0.3774	0.0057		
19			medium	2442	73.978%	1.639%	0.3774	0.0088		
20			high	494	14.965%	0.331%	0.3774	0.0095		
21			average	3301	100.000%	2.215%	0.3774	0.0084		
22										
23										
24		average	low	24138	16.197%	16.197%		-0.0084		
25			medium	105330	70.679%	70.679%		0.0008		
26			high	19558	13.124%	13.124%		0.0060		
27			average	149025	100.000%	100.000%		0.0000		
28										

	R	S	T	U	V	W	X	Y	Z
1									
2									
3	*Determining part 1 of the prior relativities for Years Licensed*								
4									
5			Exposure			Prior	Part of		
6			#	% of categor	% of total	Relativity	Average		
7	Safety Record	Yrs. Lic.							
8	0	0 - 7	16585	13.066%	11.129%	-0.0372	-0.0298		
9		8 - 14	19049	15.007%	12.782%	-0.0372	-0.0306		
10		15 +	91303	71.928%	61.267%	-0.0372	-0.0324		
11		average	126937	100.000%	85.178%	-0.0372	-0.0317		
12									
13	1	0 - 7	3330	17.725%	2.235%	0.1853	0.0297		
14		8 - 14	3480	18.523%	2.335%	0.1853	0.0278		
15		15 +	11978	63.757%	8.038%	0.1853	0.0211		
16		average	18787	100.000%	12.607%	0.1853	0.0234		
17									
18	2	0 - 7	842	25.507%	0.565%	0.3774	0.0153		
19		8 - 14	651	19.721%	0.437%	0.3774	0.0106		
20		15 +	1808	54.771%	1.213%	0.3774	0.0065		
21		average	3301	100.000%	2.215%	0.3774	0.0084		
22									
23									
24	average	0 - 7	20757	13.929%	13.929%		0.0153		
25		8 - 14	23180	15.554%	15.554%		0.0078		
26		15 +	105089	70.518%	70.518%		-0.0047		
27		average	149025	100.000%	100.000%		0.0000		
28									

	AA	AB	AC	AD	AE	AF	AG	A
1								
2								
3	*Determining part 2 of the prior relativities for Years Licensed*							
4								
5			Exposure			Indicated	Part of	
6			#	of category	% of total	Relativity	Average	
7	Mileage	Yrs. Lic.						
8	low	0 - 7	1513	6.268%	1.015%	-0.1316	-0.0096	
9		8 - 14	1829	7.578%	1.227%	-0.1316	-0.0104	
10		15 +	20795	86.154%	13.954%	-0.1316	-0.0260	
11		average	24137	100.000%	16.197%	-0.1316	-0.0213	
12								
13	medium	0 - 7	16140	15.323%	10.830%	-0.0319	-0.0248	
14		8 - 14	17222	16.350%	11.556%	-0.0319	-0.0237	
15		15 +	71969	68.327%	48.293%	-0.0319	-0.0218	
16		average	105331	100.000%	70.680%	-0.0319	-0.0225	
17								
18	high	0 - 7	3104	15.871%	2.083%	0.3339	0.0499	
19		8 - 14	4128	21.106%	2.770%	0.3339	0.0595	
20		15 +	12326	63.023%	8.271%	0.3339	0.0392	
21		average	19558	100.000%	13.124%	0.3339	0.0438	
22								
23	average	0 - 7	20757	13.928%	13.928%		0.0156	
24		8 - 14	23179	15.554%	15.554%		0.0254	
25		15 +	105090	70.518%	70.518%		-0.0087	
26		average	149026	100.000%	100.000%		0.0000	
27								
28								

	A	B	C	D	E	F
1	C. Sequentia					
2	Additive Mod					
3						
4						
5			Unadjusted	Unadjusted	Average	Adjusted
6		Categories	Average Loss	dicated Relativity	PRFPF	ated Relativity
7	Step 1.					
8	Safety	0	149.280347	=C8/$C$11-1	0	=(D8-E8)
9	Record	1	183.785927	=C9/$C$11-1	0	=(D9-E9)
10		2	213.576692	=C10/$C$11-1	0	=(D10-E10)
11		average	155.054756	=C11/$C$11-1	0	=(D11-E11)
12	Step 2.					
13	Mileage	low	133.345152	=C13/$C$16-1	=O24	=(D13-E13)
14		medium	150.2434	=C14/$C$16-1	=O25	=(D14-E14)
15		high	207.758208	=C15/$C$16-1	=O26	=(D15-E15)
16		average	155.054756	=C16/$C$16-1	=O27	=(D16-E16)
17						
18	Step 3.					
19	Years					
20	Licensed	0 - 7	248.167142	=C20/$C$23-1	=X24+AG23	=(D20-E20)
21		8 - 14	159.71851	=C21/$C$23-1	=X25+AG24	=(D21-E21)
22		15 +	135.634746	=C22/$C$23-1	=X26+AG25	=(D22-E22)
23		average	155.054756	=C23/$C$23-1	=X27+AG26	=(D23-E23)
24						
25						
26						
27						
28						

	I	J	K	L	M	N	O	P
1								
2								
3	*Determi*							
4								
5				Exposure		Prior	Part of	
6			#	% of category	% of total	Relative	Average	
7	afety Record	Mileage						
8	0	low	21330	=K8/K11	=K8/K$27	=$F$8	=(M8/M$24)*N8	
9		medium	89420	=K9/K11	=K9/K$27	=$F$8	=(M9/M$25)*N9	
10		high	16187	=K10/K11	=K10/K$27	=$F$8	=(M10/M$26)*N10	
11		average	126937	=K11/K11	=K11/K$27	=$F$8	=(M11/M$27)*N11	
12								
13	1	low	2443	=K13/K16	=K13/K$27	=$F$9	=(M13/M$24)*N13	
14		medium	13468	=K14/K16	=K14/K$27	=$F$9	=(M14/M$25)*N14	
15		high	2877	=K15/K16	=K15/K$27	=$F$9	=(M15/M$26)*N15	
16		average	18787	=K16/K16	=K16/K$27	=$F$9	=(M16/M$27)*N16	
17								
18	2+	low	365	=K18/K21	=K18/K$27	=$F$10	=(M18/M$24)*N18	
19		medium	2442	=K19/K21	=K19/K$27	=$F$10	=(M19/M$25)*N19	
20		high	494	=K20/K21	=K20/K$27	=$F$10	=(M20/M$26)*N20	
21		average	3301	=K21/K21	=K21/K$27	=$F$10	=(M21/M$27)*N21	
22								
23								
24	average	low	=SUM(K	=K24/K27	=SUM(M8,M13,M18)		=SUM(O8,O13,O18)	
25		medium	=SUM(K	=K25/K27	=SUM(M9,M14,M19)		=SUM(O9,O14,O19)	
26		high	=SUM(K	=K26/K27	=SUM(M10,M15,M20)		=SUM(O10,O15,O20)	
27		average	=SUM(K	=K27/K27	=SUM(M11,M16,M21)		=SUM(O11,O16,O21)	
28								

	R	S	T	U	V	W	X	Y
1								
2								
3	*Deter*							
4								
5				Exposure		Prior	Part of	
6			#	% of category	% of total	Relativity	Average	
7	ty Record	Yrs. Lic.						
8	0	0 - 7	16585	=T8/T11	=T8/T$27	=$F$8	=(V8/V$24)*W8	
9		8 - 14	19049	=T9/T11	=T9/T$27	=$F$8	=(V9/V$25)*W9	
10		15 +	91303	=T10/T11	=T10/T$27	=$F$8	=(V10/V$26)*W10	
11		average	126937	=T11/T11	=T11/T$27	=$F$8	=(V11/V$27)*W11	
12								
13	1	0 - 7	3330	=T13/T16	=T13/T$27	=$F$9	=(V13/V$24)*W13	
14		8 - 14	3480	=T14/T16	=T14/T$27	=$F$9	=(V14/V$25)*W14	
15		15 +	11978	=T15/T16	=T15/T$27	=$F$9	=(V15/V$26)*W15	
16		average	18787	=T16/T16	=T16/T$27	=$F$9	=(V16/V$27)*W16	
17								
18	2	0 - 7	842	=T18/T21	=T18/T$27	=$F$10	=(V18/V$24)*W18	
19		8 - 14	651	=T19/T21	=T19/T$27	=$F$10	=(V19/V$25)*W19	
20		15 +	1808	=T20/T21	=T20/T$27	=$F$10	=(V20/V$26)*W20	
21		average	3301	=T21/T21	=T21/T$27	=$F$10	=(V21/V$27)*W21	
22								
23								
24	average	0 - 7	=SUM(T8,	=T24/T27	=SUM(V8,V13,V18)		=SUM(X8,X13,X18)	
25		8 - 14	=SUM(T9,	=T25/T27	=SUM(V9,V14,V19)		=SUM(X9,X14,X19)	
26		15 +	=SUM(T1	=T26/T27	=SUM(V10,V15,V20)		=SUM(X10,X15,X20)	
27		average	=SUM(T1	=T27/T27	=SUM(V11,V16,V21)		=SUM(X11,X16,X21)	
28								

	AA	AB	AC	AD	AE	AF	AG	AH
1								
2								
3	*Deter*							
4								
5			Exposur			Indicated	Part of	
6			#	% of category	% of total	Relativity	Average	
7	Mileage	Yrs. Lic.						
8	low	0 - 7	1513	=AC8/AC11	=AC8/$AC$26	=$F$13	=(AE8/$AE$23)*AF8	
9		8 - 14	1829	=AC9/AC11	=AC9/$AC$26	=$F$13	=(AE9/$AE$24)*AF9	
10		15 +	20795	=AC10/AC11	=AC10/$AC$26	=$F$13	=(AE10/$AE$25)*AF10	
11		average	24137	=AC11/AC11	=AC11/$AC$26	=$F$13	=(AE11/$AE$26)*AF11	
12								
13	medium	0 - 7	16140	=AC13/AC16	=AC13/$AC$26	=$F$14	=(AE13/$AE$23)*AF13	
14		8 - 14	17222	=AC14/AC16	=AC14/$AC$26	=$F$14	=(AE14/$AE$24)*AF14	
15		15 +	71969	=AC15/AC16	=AC15/$AC$26	=$F$14	=(AE15/$AE$25)*AF15	
16		average	105331	=AC16/AC16	=AC16/$AC$26	=$F$14	=(AE16/$AE$26)*AF16	
17								
18	high	0 - 7	3104	=AC18/AC21	=AC18/$AC$26	=$F$15	=(AE18/$AE$23)*AF18	
19		8 - 14	4128	=AC19/AC21	=AC19/$AC$26	=$F$15	=(AE19/$AE$24)*AF19	
20		15 +	12326	=AC20/AC21	=AC20/$AC$26	=$F$15	=(AE20/$AE$25)*AF20	
21		average	19558	=AC21/AC21	=AC21/$AC$26	=$F$15	=(AE21/$AE$26)*AF21	
22								
23	average	0 - 7	=SUM(A	=AC23/AC26	=AC23/$AC$26		=SUM(AG8,AG13,AG18)	
24		8 - 14	=SUM(A	=AC24/AC26	=AC24/$AC$26		=SUM(AG9,AG14,AG19)	
25		15 +	=SUM(A	=AC25/AC26	=AC25/$AC$26		=SUM(AG10,AG15,AG20)	
26		average	=SUM(A	=AC26/AC26	=AC26/$AC$26		=SUM(AG11,AG16,AG21)	
27								
28								

Attachment C

Sequential Analysis Using Summary Data and Multiplicative Algorithm

	A	B	C	D	E	F	G	H
1	C. Sequential Analysis Using Summary Data and Prior Relativities Approach							
2	Multiplicative Model: Premium = Base Rate * F1 * F2 * F3 * GDD							
3								
4								
5			Unadjusted	Unadjusted	Average	Adjusted		
6		Categories	Average Loss	Indicated Relativity	PRFPF	Indicated Relativity		
7								
8	Step 1.	no	289.00	1.8639	1.0000	1.2296		
9	GDD	yes	145.52	0.9385	1.0000	0.9837		
10		average	155.05	1.0000	1.0000	1.0000		
11								
12	Step 2.							
13	Safety	0	149.28	0.9628	0.9955	0.9671		
14	Record	1	183.79	1.1853	0.9981	1.1875		
15		2+	213.58	1.3774	1.1820	1.1654		
16		average	155.05	1.0000	1.0000	1.0000		
17								
18	Step 3.							
19	Mileage	low	133.35	0.8600	0.9863	0.8719		
20		medium	150.24	0.9690	1.0020	0.9671		
21		high	207.76	1.3399	1.0063	1.3315		
22		average	155.05	1.0000	1.0000	1.0000		
23								
24	Step 4.							
25	Years	0 - 7	248.17	1.6005	1.1052	1.4481		
26	Licensed	8 - 14	159.72	1.0301	1.0201	1.0098		
27		15 +	135.63	0.8748	0.9748	0.8974		
28		average	155.05	1.0000	1.0000	1.0000		
29								
30								
31	NOTE: Adjusted Indicated Relativities for GDD set so as to provide the required 20% difference.							
32								
33								
34								
35								
36								
37								
38								
39								
40								
41								
42								

	I	J	K	L	M	N	O	P	Q
1									
2									
3	*Determining prior relativities for Safety Record*								
4									
5			Exposure			Prior	Part of		
6			#	% of category	% of total	Relativity	Average		
7	GDD:	**Safety:**							
8	no	0 points	6136	61.955%	4.117%	1.2296	0.0594		
9		1 point	1107	11.177%	0.743%	1.2296	0.0724		
10		2+ points	2662	26.878%	1.786%	1.2296	0.9916		
11		average	9904	100.000%	6.646%	1.2296	0.0817		
12									
13	yes	0 points	120801	86.831%	81.060%	0.9837	0.9361		
14		1 point	17681	12.709%	11.864%	0.9837	0.9257		
15		2+ points	639	0.459%	0.429%	0.9837	0.1904		
16		average	139122	100.000%	93.354%	0.9837	0.9183		
17									
18	average	0 points	126937	85.178%	85.178%		0.9955		
19		1 point	18788	12.607%	12.607%		0.9981		
20		2+ points	3301	2.215%	2.215%		1.1820		
21		average	149026	100.000%	100.000%		1.0000		
22									
23									
24									
25									
26									
27									
28									
29									
30									
31									
32									
33									
34									
35									
36									
37									
38									
39									
40									
41									
42									

	R	S	T	U	V	W	X	Y	Z
1									
2									
3	*Determining prior relativities for Mileage*								
4									
5				Exposure			Prior	Part of	
6				#	% of category	% of total	Relativities	Average	
7	GDD:	Safety Factor:	**Mileage:**				*(GDD x safe)*		
8	no	0	low	571	9.306%	0.383%	1.1891	0.0281	
9			medium	4729	77.070%	3.173%	1.1891	0.0534	
10			high	836	13.625%	0.561%	1.1891	0.0508	
11			average	6136	100.000%	4.117%	1.1891	0.0490	
12									
13		1	low	76	6.865%	0.051%	1.4601	0.0046	
14			medium	874	78.952%	0.586%	1.4601	0.0121	
15			high	157	14.182%	0.105%	1.4601	0.0117	
16			average	1107	100.000%	0.743%	1.4601	0.0108	
17									
18		2+	low	306	11.495%	0.205%	1.4329	0.0182	
19			medium	1969	73.967%	1.321%	1.4329	0.0268	
20			high	388	14.576%	0.260%	1.4329	0.0284	
21			average	2662	100.000%	1.786%	1.4329	0.0256	
22									
23	yes	0	low	20759	17.184%	13.930%	0.9513	0.8181	
24			medium	84691	70.108%	56.830%	0.9513	0.7649	
25			high	15351	12.708%	10.301%	0.9513	0.7466	
26			average	120801	100.000%	81.060%	0.9513	0.7711	
27									
28		1	low	2367	13.387%	1.588%	1.1681	0.1145	
29			medium	12594	71.229%	8.451%	1.1681	0.1397	
30			high	2720	15.384%	1.825%	1.1681	0.1624	
31			average	17681	100.000%	11.864%	1.1681	0.1386	
32									
33		2+	low	59	9.233%	0.040%	1.1463	0.0028	
34			medium	474	74.178%	0.318%	1.1463	0.0052	
35			high	107	16.745%	0.072%	1.1463	0.0063	
36			average	639	100.000%	0.429%	1.1463	0.0049	
37									
38	average	average	low	24138	16.197%	16.197%		0.9863	
39			medium	105331	70.680%	70.680%		1.0020	
40			high	19559	13.125%	13.125%		1.0063	
41			average	149026	100.000%	100.000%		1.0000	
42									

	AB	AC	AD	AE	AF	AG	AH	AI	AJ	A
1										
2										
3	*Determining prior relativities for Years Licensed*									
4										
5					Exposure			Prior	Part of	
6					#	% of category	% of total	Relativities	Average	
7	GDD:	ty Factor:	Mileage:	Yrs. Lic.:				(GDD x safe x mile)		
8	no	0	low	0 - 7	571	100.000%	0.383%	1.0368	0.0285	
9				8 - 14	0	0.000%	0.000%	1.0368	0.0000	
10				15 +	0	0.000%	0.000%	1.0368	0.0000	
11				average	571	100.000%	0.383%	1.0368	0.0040	
12										
13			medium	0 - 7	4729	100.000%	3.173%	1.1499	0.2620	
14				8 - 14	0	0.000%	0.000%	1.1499	0.0000	
15				15 +	0	0.000%	0.000%	1.1499	0.0000	
16				average	4729	100.000%	3.173%	1.1499	0.0365	
17										
18			high	0 - 7	836	100.000%	0.561%	1.5833	0.0638	
19				8 - 14	0	0.000%	0.000%	1.5833	0.0000	
20				15 +	0	0.000%	0.000%	1.5833	0.0000	
21				average	836	100.000%	0.561%	1.5833	0.0089	
22										
23		1	low	0 - 7	76	100.000%	0.051%	1.2731	0.0047	
24				8 - 14	0	0.000%	0.000%	1.2731	0.0000	
25				15 +	0	0.000%	0.000%	1.2731	0.0000	
26				average	76	100.000%	0.051%	1.2731	0.0006	
27										
28			medium	0 - 7	874	100.000%	0.586%	1.4120	0.0594	
29				8 - 14	0	0.000%	0.000%	1.4120	0.0000	
30				15 +	0	0.000%	0.000%	1.4120	0.0000	
31				average	874	100.000%	0.586%	1.4120	0.0083	
32										
33			high	0 - 7	157	100.000%	0.105%	1.9442	0.0147	
34				8 - 14	0	0.000%	0.000%	1.9442	0.0000	
35				15 +	0	0.000%	0.000%	1.9442	0.0000	
36				average	157	100.000%	0.105%	1.9442	0.0020	
37										
38		2+	low	0 - 7	47	15.359%	0.032%	1.2494	0.0028	
39				8 - 14	30	9.804%	0.020%	1.2494	0.0016	
40				15 +	229	74.837%	0.154%	1.2494	0.0027	
41				average	306	100.000%	0.205%	1.2494	0.0026	
42										
43			medium	0 - 7	552	28.035%	0.370%	1.3857	0.0368	
44				8 - 14	388	19.705%	0.260%	1.3857	0.0232	
45				15 +	1028	52.209%	0.690%	1.3857	0.0136	
46				average	1969	100.000%	1.321%	1.3857	0.0183	
47										
48			high	0 - 7	107	27.577%	0.072%	1.9080	0.0098	
49				8 - 14	91	23.454%	0.061%	1.9080	0.0075	
50				15 +	190	48.969%	0.127%	1.9080	0.0034	
51				average	388	100.000%	0.260%	1.9080	0.0050	
52										
53	yes	0	low	0 - 7	688	3.314%	0.462%	0.8294	0.0275	
54				8 - 14	1562	7.524%	1.048%	0.8294	0.0559	
55				15 +	18509	89.161%	12.420%	0.8294	0.1461	
56				average	20759	100.000%	13.930%	0.8294	0.1155	
57										
58			medium	0 - 7	8153	9.627%	5.471%	0.9199	0.3613	
59				8 - 14	14116	16.668%	9.472%	0.9199	0.5602	
60				15 +	62422	73.706%	41.886%	0.9199	0.5464	
61				average	84691	100.000%	56.829%	0.9199	0.5228	
62										
63			high	0 - 7	1608	10.475%	1.079%	1.2666	0.0981	
64				8 - 14	3371	21.959%	2.262%	1.2666	0.1842	
65				15 +	10372	67.566%	6.960%	1.2666	0.1250	
66				average	15351	100.000%	10.301%	1.2666	0.1305	
67										
68		1	low	0 - 7	125	5.281%	0.084%	1.0185	0.0061	
69				8 - 14	233	9.844%	0.156%	1.0185	0.0102	
70				15 +	2009	84.875%	1.348%	1.0185	0.0195	
71				average	2367	100.000%	1.588%	1.0185	0.0162	
72										
73			medium	0 - 7	1730	13.737%	1.161%	1.1296	0.0941	
74				8 - 14	2603	20.669%	1.747%	1.1296	0.1269	
75				15 +	8262	65.603%	5.544%	1.1296	0.0888	
76				average	12594	100.000%	8.451%	1.1296	0.0955	
77										
78			high	0 - 7	369	13.566%	0.248%	1.5553	0.0276	
79				8 - 14	644	23.676%	0.432%	1.5553	0.0432	
80				15 +	1708	62.794%	1.146%	1.5553	0.0253	
81				average	2720	100.000%	1.825%	1.5553	0.0284	
82										
83		2+	low	0 - 7	7	11.864%	0.005%	0.9995	0.0003	
84				8 - 14	5	8.475%	0.003%	0.9995	0.0002	
85				15 +	48	81.356%	0.032%	0.9995	0.0005	
86				average	59	100.000%	0.040%	0.9995	0.0004	
87										
88			medium	0 - 7	102	21.519%	0.068%	1.1086	0.0054	
89				8 - 14	115	24.262%	0.077%	1.1086	0.0055	
90				15 +	257	54.219%	0.172%	1.1086	0.0027	
91				average	474	100.000%	0.318%	1.1086	0.0035	
92										
93			high	0 - 7	28	26.168%	0.019%	1.5264	0.0021	
94				8 - 14	22	20.561%	0.015%	1.5264	0.0014	
95				15 +	57	53.271%	0.038%	1.5264	0.0008	
96				average	107	100.000%	0.072%	1.5264	0.0011	
97										
98	rage	average	average	0 - 7	20759	13.930%	13.930%		1.1052	
99				8 - 14	23180	15.554%	15.554%		1.0201	
100				15 +	105091	70.518%	70.518%		0.9748	
101				average	149028	100.000%	100.000%		1.0000	
102										

	A	B	C	D	E	F
1	C. Sequential					
2	Multiplicative M					
3						
4						
5			Unadjusted	Unadjusted	Average	Adjusted
6		Categories	Average Loss	Indicated Relativity	PRFPF	Indicated Relativity
7						
8	Step 1.	no	288.999093	=C8/$C$10	1	1.22956919781719
9	GDD	yes	145.519204	=C9/$C$10	1	0.983655358253755
10		average	155.054756	=C10/$C$10	1	1
11						
12	Step 2.					
13	Safety	0	149.280347	=C13/$C$16	=O18	=D13/E13
14	Record	1	183.785927	=C14/$C$16	=O19	=D14/E14
15		2+	213.576692	=C15/$C$16	=O20	=D15/E15
16		average	155.054756	=C16/$C$16	=O21	=D16/E16
17						
18	Step 3.					
19	Mileage	low	133.345152	=C19/$C$22	=Y38	=D19/E19
20		medium	150.2434	=C20/$C$22	=Y39	=D20/E20
21		high	207.758208	=C21/$C$22	=Y40	=D21/E21
22		average	155.054756	=C22/$C$22	=Y41	=D22/E22
23						
24	Step 4.					
25	Years	0 - 7	248.167142	=C25/$C$28	=AJ98	=D25/E25
26	Licensed	8 - 14	159.71851	=C26/$C$28	=AJ99	=D26/E26
27		15 +	135.634746	=C27/$C$28	=AJ100	=D27/E27
28		average	155.054756	=C28/$C$28	=AJ101	=D28/E28
29						
30						
31	NOTE: Adjuste					
32						
33						
34						
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39						
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41						
42						

	I	J	K	L	M	N	O	P
1								
2								
3	*Determ*							
4								
5			Exposure			Prior	Part of	
6			#	% of category	% of total	Relativity	Average	
7	GDD:	**Safety:**						
8	no	0 points	6136	=K8/K11	=K8/K$21	=$F$8	=(M8/M$18)*N8	
9		1 point	1107	=K9/K11	=K9/K$21	=$F$8	=(M9/M$19)*N9	
10		2+ points	2662	=K10/K11	=K10/K$21	=$F$8	=(M10/M$20)*N10	
11		average	9904	=K11/K11	=K11/K$21	=$F$8	=(M11/M$21)*N11	
12								
13	yes	0 points	120801	=K13/K16	=K13/K$21	=$F$9	=(M13/M$18)*N13	
14		1 point	17681	=K14/K16	=K14/K$21	=$F$9	=(M14/M$19)*N14	
15		2+ points	639	=K15/K16	=K15/K$21	=$F$9	=(M15/M$20)*N15	
16		average	139122	=K16/K16	=K16/K$21	=$F$9	=(M16/M$21)*N16	
17								
18	average	0 points	=SUM(K8,K13)	=K18/K21	=K18/K$21		=SUM(O8,O13)	
19		1 point	=SUM(K9,K14)	=K19/K21	=K19/K$21		=SUM(O9,O14)	
20		2+ points	=SUM(K10,K15)	=K20/K21	=K20/K$21		=SUM(O10,O15)	
21		average	=SUM(K11,K16)	=K21/K21	=K21/K$21		=SUM(O11,O16)	
22								
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40								
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42								

	R	S	T	U	V	W	X	Y	Z
1									
2									
3	*Determining prior relativities for Mileage*								
4									
5				Exposure			Prior	Part of	
6				#	% of category	% of total	Relativities	Average	
7	GDD:	Safety Factor:	**Mileage:**				*(GDD x safe)*		
8	no	0	low	571	9.306%	0.383%	1.1891	0.0281	
9			medium	4729	77.070%	3.173%	1.1891	0.0534	
10			high	836	13.625%	0.561%	1.1891	0.0508	
11			average	6136	100.000%	4.117%	1.1891	0.0490	
12									
13		1	low	76	6.865%	0.051%	1.4601	0.0046	
14			medium	874	78.952%	0.586%	1.4601	0.0121	
15			high	157	14.182%	0.105%	1.4601	0.0117	
16			average	1107	100.000%	0.743%	1.4601	0.0108	
17									
18		2+	low	306	11.495%	0.205%	1.4329	0.0182	
19			medium	1969	73.967%	1.321%	1.4329	0.0268	
20			high	388	14.576%	0.260%	1.4329	0.0284	
21			average	2662	100.000%	1.786%	1.4329	0.0256	
22									
23	yes	0	low	20759	17.184%	13.930%	0.9513	0.8181	
24			medium	84691	70.108%	56.830%	0.9513	0.7649	
25			high	15351	12.708%	10.301%	0.9513	0.7466	
26			average	120801	100.000%	81.060%	0.9513	0.7711	
27									
28		1	low	2367	13.387%	1.588%	1.1681	0.1145	
29			medium	12594	71.229%	8.451%	1.1681	0.1397	
30			high	2720	15.384%	1.825%	1.1681	0.1624	
31			average	17681	100.000%	11.864%	1.1681	0.1386	
32									
33		2+	low	59	9.233%	0.040%	1.1463	0.0028	
34			medium	474	74.178%	0.318%	1.1463	0.0052	
35			high	107	16.745%	0.072%	1.1463	0.0063	
36			average	639	100.000%	0.429%	1.1463	0.0049	
37									
38	average	average	low	24138	16.197%	16.197%		0.9863	
39			medium	105331	70.680%	70.680%		1.0020	
40			high	19559	13.125%	13.125%		1.0063	
41			average	149026	100.000%	100.000%		1.0000	
42									

	AB	AC	AD	AE	AF	AG	AH	AI	AJ	A
1										
2										
3	*Determining prior relativities for Years Licensed*									
4										
5					Exposure				Prior	Part of
6					#	% of category	% of total		Relativities	Average
7	GDD:	ty Factor:	Mileage:	Yrs. Lic.:					(GDD x safe x mile)	
8	no	0	low	0 - 7	571	100.000%	0.383%	1.0368	0.0285	
9				8 - 14	0	0.000%	0.000%	1.0368	0.0000	
10				15 +	0	0.000%	0.000%	1.0368	0.0000	
11				average	571	100.000%	0.383%	1.0368	0.0040	
12										
13			medium	0 - 7	4729	100.000%	3.173%	1.1499	0.2620	
14				8 - 14	0	0.000%	0.000%	1.1499	0.0000	
15				15 +	0	0.000%	0.000%	1.1499	0.0000	
16				average	4729	100.000%	3.173%	1.1499	0.0365	
17										
18			high	0 - 7	836	100.000%	0.561%	1.5833	0.0638	
19				8 - 14	0	0.000%	0.000%	1.5833	0.0000	
20				15 +	0	0.000%	0.000%	1.5833	0.0000	
21				average	836	100.000%	0.561%	1.5833	0.0089	
22										
23		1	low	0 - 7	76	100.000%	0.051%	1.2731	0.0047	
24				8 - 14	0	0.000%	0.000%	1.2731	0.0000	
25				15 +	0	0.000%	0.000%	1.2731	0.0000	
26				average	76	100.000%	0.051%	1.2731	0.0006	
27										
28			medium	0 - 7	874	100.000%	0.586%	1.4120	0.0594	
29				8 - 14	0	0.000%	0.000%	1.4120	0.0000	
30				15 +	0	0.000%	0.000%	1.4120	0.0000	
31				average	874	100.000%	0.586%	1.4120	0.0083	
32										
33			high	0 - 7	157	100.000%	0.105%	1.9442	0.0147	
34				8 - 14	0	0.000%	0.000%	1.9442	0.0000	
35				15 +	0	0.000%	0.000%	1.9442	0.0000	
36				average	157	100.000%	0.105%	1.9442	0.0020	
37										
38		2+	low	0 - 7	47	15.359%	0.032%	1.2494	0.0028	
39				8 - 14	30	9.804%	0.020%	1.2494	0.0016	
40				15 +	229	74.837%	0.154%	1.2494	0.0027	
41				average	306	100.000%	0.205%	1.2494	0.0026	
42										
43			medium	0 - 7	552	28.035%	0.370%	1.3857	0.0368	
44				8 - 14	388	19.705%	0.260%	1.3857	0.0232	
45				15 +	1028	52.209%	0.690%	1.3857	0.0136	
46				average	1969	100.000%	1.321%	1.3857	0.0183	
47										
48			high	0 - 7	107	27.577%	0.072%	1.9080	0.0098	
49				8 - 14	91	23.454%	0.061%	1.9080	0.0075	
50				15 +	190	48.969%	0.127%	1.9080	0.0034	
51				average	388	100.000%	0.260%	1.9080	0.0050	
52										
53	yes	0	low	0 - 7	688	3.314%	0.462%	0.8294	0.0275	
54				8 - 14	1562	7.524%	1.048%	0.8294	0.0559	
55				15 +	18509	89.161%	12.420%	0.8294	0.1461	
56				average	20759	100.000%	13.930%	0.8294	0.1155	
57										
58			medium	0 - 7	8153	9.627%	5.471%	0.9199	0.3613	
59				8 - 14	14116	16.668%	9.472%	0.9199	0.5602	
60				15 +	62422	73.706%	41.886%	0.9199	0.5464	
61				average	84691	100.000%	56.829%	0.9199	0.5228	
62										
63			high	0 - 7	1608	10.475%	1.079%	1.2666	0.0981	
64				8 - 14	3371	21.959%	2.262%	1.2666	0.1842	
65				15 +	10372	67.566%	6.960%	1.2666	0.1250	
66				average	15351	100.000%	10.301%	1.2666	0.1305	
67										
68		1	low	0 - 7	125	5.281%	0.084%	1.0185	0.0061	
69				8 - 14	233	9.844%	0.156%	1.0185	0.0102	
70				15 +	2009	84.875%	1.348%	1.0185	0.0195	
71				average	2367	100.000%	1.588%	1.0185	0.0162	
72										
73			medium	0 - 7	1730	13.737%	1.161%	1.1296	0.0941	
74				8 - 14	2603	20.669%	1.747%	1.1296	0.1269	
75				15 +	8262	65.603%	5.544%	1.1296	0.0888	
76				average	12594	100.000%	8.451%	1.1296	0.0955	
77										
78			high	0 - 7	369	13.566%	0.248%	1.5553	0.0276	
79				8 - 14	644	23.676%	0.432%	1.5553	0.0432	
80				15 +	1708	62.794%	1.146%	1.5553	0.0253	
81				average	2720	100.000%	1.825%	1.5553	0.0284	
82										
83		2+	low	0 - 7	7	11.864%	0.005%	0.9995	0.0003	
84				8 - 14	5	8.475%	0.003%	0.9995	0.0002	
85				15 +	48	81.356%	0.032%	0.9995	0.0005	
86				average	59	100.000%	0.040%	0.9995	0.0004	
87										
88			medium	0 - 7	102	21.519%	0.068%	1.1086	0.0054	
89				8 - 14	115	24.262%	0.077%	1.1086	0.0055	
90				15 +	257	54.219%	0.172%	1.1086	0.0027	
91				average	474	100.000%	0.318%	1.1086	0.0035	
92										
93			high	0 - 7	28	26.168%	0.019%	1.5264	0.0021	
94				8 - 14	22	20.561%	0.015%	1.5264	0.0014	
95				15 +	57	53.271%	0.038%	1.5264	0.0008	
96				average	107	100.000%	0.072%	1.5264	0.0011	
97										
98	rage	average	average	0 - 7	20759	13.930%	13.930%		1.1052	
99				8 - 14	23180	15.554%	15.554%		1.0201	
100				15 +	105091	70.518%	70.518%		0.9748	
101				average	149028	100.000%	100.000%		1.0000	
102										

	A	B	C	D	E	F
1	C. Sequential					
2	Multiplicative M					
3						
4						
5			Unadjusted	Unadjusted	Average	Adjusted
6		Categories	Average Loss	Indicated Relativity	PRFPF	Indicated Relativity
7						
8	Step 1.	no	288.999093	=C8/$C$10	1	1.22956919781719
9	GDD	yes	145.519204	=C9/$C$10	1	0.983655358253755
10		average	155.054756	=C10/$C$10	1	1
11						
12	Step 2.					
13	Safety	0	149.280347	=C13/$C$16	=O18	=D13/E13
14	Record	1	183.785927	=C14/$C$16	=O19	=D14/E14
15		2+	213.576692	=C15/$C$16	=O20	=D15/E15
16		average	155.054756	=C16/$C$16	=O21	=D16/E16
17						
18	Step 3.					
19	Mileage	low	133.345152	=C19/$C$22	=Y38	=D19/E19
20		medium	150.2434	=C20/$C$22	=Y39	=D20/E20
21		high	207.758208	=C21/$C$22	=Y40	=D21/E21
22		average	155.054756	=C22/$C$22	=Y41	=D22/E22
23						
24	Step 4.					
25	Years	0 - 7	248.167142	=C25/$C$28	=AJ98	=D25/E25
26	Licensed	8 - 14	159.71851	=C26/$C$28	=AJ99	=D26/E26
27		15 +	135.634746	=C27/$C$28	=AJ100	=D27/E27
28		average	155.054756	=C28/$C$28	=AJ101	=D28/E28
29						
30						
31	NOTE: Adjuste					
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42						

	I	J	K	L	M	N	O	P
1								
2								
3	*Determ*							
4								
5			Exposure			Prior	Part of	
6			#	% of category	% of total	Relativity	Average	
7	GDD:	**Safety:**						
8	no	0 points	6136	=K8/K11	=K8/K$21	=$F$8	=(M8/M$18)*N8	
9		1 point	1107	=K9/K11	=K9/K$21	=$F$8	=(M9/M$19)*N9	
10		2+ points	2662	=K10/K11	=K10/K$21	=$F$8	=(M10/M$20)*N10	
11		average	9904	=K11/K11	=K11/K$21	=$F$8	=(M11/M$21)*N11	
12								
13	yes	0 points	120801	=K13/K16	=K13/K$21	=$F$9	=(M13/M$18)*N13	
14		1 point	17681	=K14/K16	=K14/K$21	=$F$9	=(M14/M$19)*N14	
15		2+ points	639	=K15/K16	=K15/K$21	=$F$9	=(M15/M$20)*N15	
16		average	139122	=K16/K16	=K16/K$21	=$F$9	=(M16/M$21)*N16	
17								
18	average	0 points	=SUM(K8,K13)	=K18/K21	=K18/K$21		=SUM(O8,O13)	
19		1 point	=SUM(K9,K14)	=K19/K21	=K19/K$21		=SUM(O9,O14)	
20		2+ points	=SUM(K10,K15)	=K20/K21	=K20/K$21		=SUM(O10,O15)	
21		average	=SUM(K11,K16)	=K21/K21	=K21/K$21		=SUM(O11,O16)	
22								
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	R	S	T	U	V	W	X	Y	Z
1									
2									
3	*Deter*								
4									
5				Exposure			Prior	Part of	
6				#	% of category	% of total	Relativities	Average	
7	GDD:	ety Factor:	**Mileage:**				*(GDD x safe)*		
8	no	0	low	571	=U8/U11	=U8/U$41	=$F$8*$F$13	=(W8/W$38)*X8	
9			medium	4729	=U9/U11	=U9/U$41	=$F$8*$F$13	=(W9/W$39)*X9	
10			high	836	=U10/U11	=U10/U$41	=$F$8*$F$13	=(W10/W$40)*X10	
11			average	6136	=U11/U11	=U11/U$41	=$F$8*$F$13	=(W11/W$41)*X11	
12									
13		1	low	76	=U13/U16	=U13/U$41	=$F$8*$F$14	=(W13/W$38)*X13	
14			medium	874	=U14/U16	=U14/U$41	=$F$8*$F$14	=(W14/W$39)*X14	
15			high	157	=U15/U16	=U15/U$41	=$F$8*$F$14	=(W15/W$40)*X15	
16			average	1107	=U16/U16	=U16/U$41	=$F$8*$F$14	=(W16/W$41)*X16	
17									
18		2+	low	306	=U18/U21	=U18/U$41	=$F$8*$F$15	=(W18/W$38)*X18	
19			medium	1969	=U19/U21	=U19/U$41	=$F$8*$F$15	=(W19/W$39)*X19	
20			high	388	=U20/U21	=U20/U$41	=$F$8*$F$15	=(W20/W$40)*X20	
21			average	2662	=U21/U21	=U21/U$41	=$F$8*$F$15	=(W21/W$41)*X21	
22									
23	yes	0	low	20759	=U23/U26	=U23/U$41	=$F$9*$F$13	=(W23/W$38)*X23	
24			medium	84691	=U24/U26	=U24/U$41	=$F$9*$F$13	=(W24/W$39)*X24	
25			high	15351	=U25/U26	=U25/U$41	=$F$9*$F$13	=(W25/W$40)*X25	
26			average	120801	=U26/U26	=U26/U$41	=$F$9*$F$13	=(W26/W$41)*X26	
27									
28		1	low	2367	=U28/U31	=U28/U$41	=$F$9*$F$14	=(W28/W$38)*X28	
29			medium	12594	=U29/U31	=U29/U$41	=$F$9*$F$14	=(W29/W$39)*X29	
30			high	2720	=U30/U31	=U30/U$41	=$F$9*$F$14	=(W30/W$40)*X30	
31			average	17681	=U31/U31	=U31/U$41	=$F$9*$F$14	=(W31/W$41)*X31	
32									
33		2+	low	59	=U33/U36	=U33/U$41	=$F$9*$F$15	=(W33/W$38)*X33	
34			medium	474	=U34/U36	=U34/U$41	=$F$9*$F$15	=(W34/W$39)*X34	
35			high	107	=U35/U36	=U35/U$41	=$F$9*$F$15	=(W35/W$40)*X35	
36			average	639	=U36/U36	=U36/U$41	=$F$9*$F$15	=(W36/W$41)*X36	
37									
38	average	average	low	=SUM(U	=U38/U41	=U38/U$41		=SUM(Y8,Y13,Y18,Y23,Y28,Y33)	
39			medium	=SUM(U	=U39/U41	=U39/U$41		=SUM(Y9,Y14,Y19,Y24,Y29,Y34)	
40			high	=SUM(U	=U40/U41	=U40/U$41		=SUM(Y10,Y15,Y20,Y25,Y30,Y35	
41			average	=SUM(U	=U41/U41	=U41/U$41		=SUM(Y11,Y16,Y21,Y26,Y31,Y36	
42									

	AB	AC	AD	AE	AF	AG	AH	AI	AJ	AK
1										
2										
3	*Data*									
4										
5					Exposur			Prior	Part of	
6					#	% of category	% of total	Relativities	Average	
7	GDD:	Factor:	Mileage:	Yrs. Lic.:				*(GDD x safe x mile)*		
8	no	0	low	0 - 7	571	=AF8/AF11	=AF8/$AF$101	=$F$8*$F$13*$F$19	=(AH8/$AH$98)*AI8	
9				8 - 14	0	=AF9/AF11	=AF9/$AF$101	=$F$8*$F$13*$F$19	=(AH9/$AH$99)*AI9	
10				15 +	0	=AF10/AF11	=AF10/$AF$101	=$F$8*$F$13*$F$19	=(AH10/$AH$100)*AI10	
11				average	571	=AF11/AF11	=AF11/$AF$101	=$F$8*$F$13*$F$19	=(AH11/$AH$101)*AI11	
12										
13			medium	0 - 7	4729	=AF13/AF16	=AF13/$AF$101	=$F$8*$F$13*$F$20	=(AH13/$AH$98)*AI13	
14				8 - 14	0	=AF14/AF16	=AF14/$AF$101	=$F$8*$F$13*$F$20	=(AH14/$AH$99)*AI14	
15				15 +	0	=AF15/AF16	=AF15/$AF$101	=$F$8*$F$13*$F$20	=(AH15/$AH$100)*AI15	
16				average	4729	=AF16/AF16	=AF16/$AF$101	=$F$8*$F$13*$F$20	=(AH16/$AH$101)*AI16	
17										
18			high	0 - 7	836	=AF18/AF21	=AF18/$AF$101	=$F$8*$F$13*$F$21	=(AH18/$AH$98)*AI18	
19				8 - 14	0	=AF19/AF21	=AF19/$AF$101	=$F$8*$F$13*$F$21	=(AH19/$AH$99)*AI19	
20				15 +	0	=AF20/AF21	=AF20/$AF$101	=$F$8*$F$13*$F$21	=(AH20/$AH$100)*AI20	
21				average	836	=AF21/AF21	=AF21/$AF$101	=$F$8*$F$13*$F$21	=(AH21/$AH$101)*AI21	
22										
23		1	low	0 - 7	76	=AF23/AF26	=AF23/$AF$101	=$F$8*$F$14*$F$19	=(AH23/$AH$98)*AI23	
24				8 - 14	0	=AF24/AF26	=AF24/$AF$101	=$F$8*$F$14*$F$19	=(AH24/$AH$99)*AI24	
25				15 +	0	=AF25/AF26	=AF25/$AF$101	=$F$8*$F$14*$F$19	=(AH25/$AH$100)*AI25	
26				average	76	=AF26/AF26	=AF26/$AF$101	=$F$8*$F$14*$F$19	=(AH26/$AH$101)*AI26	
27										
28			medium	0 - 7	874	=AF28/AF31	=AF28/$AF$101	=$F$8*$F$14*$F$20	=(AH28/$AH$98)*AI28	
29				8 - 14	0	=AF29/AF31	=AF29/$AF$101	=$F$8*$F$14*$F$20	=(AH29/$AH$99)*AI29	
30				15 +	0	=AF30/AF31	=AF30/$AF$101	=$F$8*$F$14*$F$20	=(AH30/$AH$100)*AI30	
31				average	874	=AF31/AF31	=AF31/$AF$101	=$F$8*$F$14*$F$20	=(AH31/$AH$101)*AI31	
32										
33			high	0 - 7	157	=AF33/AF36	=AF33/$AF$101	=$F$8*$F$14*$F$21	=(AH33/$AH$98)*AI33	
34				8 - 14	0	=AF34/AF36	=AF34/$AF$101	=$F$8*$F$14*$F$21	=(AH34/$AH$99)*AI34	
35				15 +	0	=AF35/AF36	=AF35/$AF$101	=$F$8*$F$14*$F$21	=(AH35/$AH$100)*AI35	
36				average	157	=AF36/AF36	=AF36/$AF$101	=$F$8*$F$14*$F$21	=(AH36/$AH$101)*AI36	
37										
38		2+	low	0 - 7	47	=AF38/AF41	=AF38/$AF$101	=$F$8*$F$15*$F$19	=(AH38/$AH$98)*AI38	
39				8 - 14	30	=AF39/AF41	=AF39/$AF$101	=$F$8*$F$15*$F$19	=(AH39/$AH$99)*AI39	
40				15 +	229	=AF40/AF41	=AF40/$AF$101	=$F$8*$F$15*$F$19	=(AH40/$AH$100)*AI40	
41				average	306	=AF41/AF41	=AF41/$AF$101	=$F$8*$F$15*$F$19	=(AH41/$AH$101)*AI41	
42										
43			medium	0 - 7	552	=AF43/AF46	=AF43/$AF$101	=$F$8*$F$15*$F$20	=(AH43/$AH$98)*AI43	
44				8 - 14	388	=AF44/AF46	=AF44/$AF$101	=$F$8*$F$15*$F$20	=(AH44/$AH$99)*AI44	
45				15 +	1028	=AF45/AF46	=AF45/$AF$101	=$F$8*$F$15*$F$20	=(AH45/$AH$100)*AI45	
46				average	1969	=AF46/AF46	=AF46/$AF$101	=$F$8*$F$15*$F$20	=(AH46/$AH$101)*AI46	
47										
48			high	0 - 7	107	=AF48/AF51	=AF48/$AF$101	=$F$8*$F$15*$F$21	=(AH48/$AH$98)*AI48	
49				8 - 14	91	=AF49/AF51	=AF49/$AF$101	=$F$8*$F$15*$F$21	=(AH49/$AH$99)*AI49	
50				15 +	190	=AF50/AF51	=AF50/$AF$101	=$F$8*$F$15*$F$21	=(AH50/$AH$100)*AI50	
51				average	388	=AF51/AF51	=AF51/$AF$101	=$F$8*$F$15*$F$21	=(AH51/$AH$101)*AI51	
52										
53	yes	0	low	0 - 7	688	=AF53/AF56	=AF53/$AF$101	=$F$9*$F$13*$F$19	=(AH53/$AH$98)*AI53	
54				8 - 14	1562	=AF54/AF56	=AF54/$AF$101	=$F$9*$F$13*$F$19	=(AH54/$AH$99)*AI54	
55				15 +	18509	=AF55/AF56	=AF55/$AF$101	=$F$9*$F$13*$F$19	=(AH55/$AH$100)*AI55	
56				average	20759	=AF56/AF56	=AF56/$AF$101	=$F$9*$F$13*$F$19	=(AH56/$AH$101)*AI56	
57										
58			medium	0 - 7	8153	=AF58/AF61	=AF58/$AF$101	=$F$9*$F$13*$F$20	=(AH58/$AH$98)*AI58	
59				8 - 14	14116	=AF59/AF61	=AF59/$AF$101	=$F$9*$F$13*$F$20	=(AH59/$AH$99)*AI59	
60				15 +	62422	=AF60/AF61	=AF60/$AF$101	=$F$9*$F$13*$F$20	=(AH60/$AH$100)*AI60	
61				average	84691	=AF61/AF61	=AF61/$AF$101	=$F$9*$F$13*$F$20	=(AH61/$AH$101)*AI61	
62										
63			high	0 - 7	1608	=AF63/AF66	=AF63/$AF$101	=$F$9*$F$13*$F$21	=(AH63/$AH$98)*AI63	
64				8 - 14	3371	=AF64/AF66	=AF64/$AF$101	=$F$9*$F$13*$F$21	=(AH64/$AH$99)*AI64	
65				15 +	10372	=AF65/AF66	=AF65/$AF$101	=$F$9*$F$13*$F$21	=(AH65/$AH$100)*AI65	
66				average	15351	=AF66/AF66	=AF66/$AF$101	=$F$9*$F$13*$F$21	=(AH66/$AH$101)*AI66	
67										
68		1	low	0 - 7	125	=AF68/AF71	=AF68/$AF$101	=$F$9*$F$14*$F$19	=(AH68/$AH$98)*AI68	
69				8 - 14	233	=AF69/AF71	=AF69/$AF$101	=$F$9*$F$14*$F$19	=(AH69/$AH$99)*AI69	
70				15 +	2009	=AF70/AF71	=AF70/$AF$101	=$F$9*$F$14*$F$19	=(AH70/$AH$100)*AI70	
71				average	2367	=AF71/AF71	=AF71/$AF$101	=$F$9*$F$14*$F$19	=(AH71/$AH$101)*AI71	
72										
73			medium	0 - 7	1730	=AF73/AF76	=AF73/$AF$101	=$F$9*$F$14*$F$20	=(AH73/$AH$98)*AI73	
74				8 - 14	2603	=AF74/AF76	=AF74/$AF$101	=$F$9*$F$14*$F$20	=(AH74/$AH$99)*AI74	
75				15 +	8262	=AF75/AF76	=AF75/$AF$101	=$F$9*$F$14*$F$20	=(AH75/$AH$100)*AI75	
76				average	12594	=AF76/AF76	=AF76/$AF$101	=$F$9*$F$14*$F$20	=(AH76/$AH$101)*AI76	
77										
78			high	0 - 7	369	=AF78/AF81	=AF78/$AF$101	=$F$9*$F$14*$F$21	=(AH78/$AH$98)*AI78	
79				8 - 14	644	=AF79/AF81	=AF79/$AF$101	=$F$9*$F$14*$F$21	=(AH79/$AH$99)*AI79	
80				15 +	1708	=AF80/AF81	=AF80/$AF$101	=$F$9*$F$14*$F$21	=(AH80/$AH$100)*AI80	
81				average	2720	=AF81/AF81	=AF81/$AF$101	=$F$9*$F$14*$F$21	=(AH81/$AH$101)*AI81	
82										
83		2+	low	0 - 7	7	=AF83/AF86	=AF83/$AF$101	=$F$9*$F$15*$F$19	=(AH83/$AH$98)*AI83	
84				8 - 14	5	=AF84/AF86	=AF84/$AF$101	=$F$9*$F$15*$F$19	=(AH84/$AH$99)*AI84	
85				15 +	48	=AF85/AF86	=AF85/$AF$101	=$F$9*$F$15*$F$19	=(AH85/$AH$100)*AI85	
86				average	59	=AF86/AF86	=AF86/$AF$101	=$F$9*$F$15*$F$19	=(AH86/$AH$101)*AI86	
87										
88			medium	0 - 7	102	=AF88/AF91	=AF88/$AF$101	=$F$9*$F$15*$F$20	=(AH88/$AH$98)*AI88	
89				8 - 14	115	=AF89/AF91	=AF89/$AF$101	=$F$9*$F$15*$F$20	=(AH89/$AH$99)*AI89	
90				15 +	257	=AF90/AF91	=AF90/$AF$101	=$F$9*$F$15*$F$20	=(AH90/$AH$100)*AI90	
91				average	474	=AF91/AF91	=AF91/$AF$101	=$F$9*$F$15*$F$20	=(AH91/$AH$101)*AI91	
92										
93			high	0 - 7	28	=AF93/AF96	=AF93/$AF$101	=$F$9*$F$15*$F$21	=(AH93/$AH$98)*AI93	
94				8 - 14	22	=AF94/AF96	=AF94/$AF$101	=$F$9*$F$15*$F$21	=(AH94/$AH$99)*AI94	
95				15 +	57	=AF95/AF96	=AF95/$AF$101	=$F$9*$F$15*$F$21	=(AH95/$AH$100)*AI95	
96				average	107	=AF96/AF96	=AF96/$AF$101	=$F$9*$F$15*$F$21	=(AH96/$AH$101)*AI96	
97										
98	erage	erage	average	0 - 7	=SUM(A	=AF98/AF101	=AF98/$AF$101		=SUM(AJ8,AJ13,AJ18,AJ23,AJ28,AJ33,AJ38,AJ43,AJ48,AJ53,AJ58,AJ63,AJ68,AJ73,AJ78,AJ83,AJ88,AJ93)	
99				8 - 14	=SUM(A	=AF99/AF101	=AF99/$AF$101		=SUM(AJ9,AJ14,AJ19,AJ24,AJ29,AJ34,AJ39,AJ44,AJ49,AJ54,AJ59,AJ64,AJ69,AJ74,AJ79,AJ84,AJ89,AJ94)	
100				15 +	=SUM(A	=AF100/AF101	=AF100/$AF$101		=SUM(AJ10,AJ15,AJ20,AJ25,AJ30,AJ35,AJ40,AJ45,AJ50,AJ55,AJ60,AJ65,AJ70,AJ75,AJ80,AJ85,AJ90,AJ95)	
101				average	=SUM(A	=AF101/AF101	=AF101/$AF$101		=SUM(AJ11,AJ16,AJ21,AJ26,AJ31,AJ36,AJ41,AJ46,AJ51,AJ56,AJ61,AJ66,AJ71,AJ76,AJ81,AJ86,AJ91,AJ96)	
102										

Attachment D

Sequential Analysis Using Summary Data and a Mostly Additive Algorithm

	A	B	C	D	E	F	G	H
1	D. Sequential Analysis Using Summary Data and Prior Relativities Approach							
2	Additive Model **(w/GDD constraints)**: Premium = GDD * Base Rate * (1.0 + F1 + F2 + F3)							
3	= (GDD * Base) + (GDD * Base * F1) + (GDD * Base * F2) + (GDD * Base * F3)							
4								
5			Unadjusted	Unadjusted	Average	Adjusted		
6		Categories	Average Loss	Indicated Relativity	PRFPF	Indicated Relativity		
7	Step 1.							
8	GDD	no	289.00	1.8639	0.0000	1.2296		
9		yes	145.52	0.9385	0.0000	0.9837		
10		average	155.05	1.0000	0.0000	1.0000		
11								
12	Step 2.							
13	Safety	0	149.28	-0.0372	-0.0045	-0.0328		
14	Record	1	183.79	0.1853	-0.0019	0.1872		
15		2+	213.58	0.3774	0.1820	0.1955		
16		average	155.05	0.0000	0.0000	0.0000		
17								
18	Step 3.							
19	Mileage	low	133.35	-0.1400	-0.0137	-0.1263		
20		medium	150.24	-0.0310	0.0020	-0.0330		
21		high	207.76	0.3399	0.0063	0.3336		
22		average	155.05	0.0000	0.0000	0.0000		
23								
24	Step 4.							
25	Years	0 - 7	248.17	0.6005	0.1052	0.4953		
26	Licensed	8 - 14	159.72	0.0301	0.0202	0.0099		
27		15 +	135.63	-0.1252	-0.0252	-0.1000		
28		average	155.05	0.0000	0.0000	0.0000		
29								
30								
31	NOTES: GDD relativities set to meet the 20% requirement.							
32	Relativities for the categories of the factors combined with GDD are set so that the subcategories not							
33	qualified for the GDD are set to provide the 20% requirement. This constraint is determined by the							
34	equation: z = R / (1 - 0.2 * x), where:							
35		z = the relativity of the subcategory not qualified for the GDD						
36		0.8 * z = the relativity of the subcategory qualified for the GDD						
37		R = the relativity of the category undivided by GDD						
38		x = the % of the category qualified for the GDD						
39								
40				(R)	(z)	(0.8 * z)		
41	Factor:	Categories:	% qualified for GDD	Adj. Indicated Relativity	Rel. if(GDD = no)	Rel. if(GDD = yes)		
42	Safety	0	95.166%	-0.0328	-0.0405	-0.0324		
43	Record	1	94.108%	0.1872	0.2305	0.1844		
44		2+	19.358%	0.1955	0.2033	0.1627		
45		average	93.354%	0.0000				
46								
47	Mileage	low	96.056%	-0.1263	-0.1564	-0.1251		
48		medium	92.812%	-0.0330	-0.0405	-0.0324		
49		high	92.939%	0.3336	0.4098	0.3278		
50		average	93.354%	0.0000				
51								
52	Years	0 - 7	61.709%	0.4953	0.5651	0.4521		
53	Licensed	8 - 14	97.804%	0.0099	0.0123	0.0099		
54		15 +	98.623%	-0.1000	-0.1246	-0.0997		
55		average	93.354%	0.0000				
56								

	I	J	K	L	M	N	O	P	Q
1									
2									
3	*Determining prior relativities for Safety Record*								
4									
5				Exposure		Adj. Indicated	Part of		
6			#	% of category	% of total	Relativity	Average		
7	GDD	**Safety**							
8	no	0	6136	61.955%	4.117%	1.2296	0.0594		
9		1	1107	11.177%	0.743%	1.2296	0.0724		
10		2+	2662	26.878%	1.786%	1.2296	0.9916		
11		average	9904	100.000%	6.646%	1.2296	0.0817		
12									
13	yes	0	120801	86.831%	81.060%	0.9837	0.9361		
14		1	17681	12.709%	11.864%	0.9837	0.9257		
15		2+	639	0.459%	0.429%	0.9837	0.1904		
16		average	139122	100.000%	93.354%	0.9837	0.9183		
17									
18	average	0	126937	85.178%	85.178%		0.9955		
19		1	18788	12.607%	12.607%		0.9981		
20		2+	3301	2.215%	2.215%		1.1820		
21		average	149026	100.000%	100.000%		1.0000		
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	R	S	T	U	V	W	X	Y	Z
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2									
3	*Determining part 1 of the prior relativities for Mileage*								
4									
5				Exposure		Adj. Indicated	Part of		
6			#	% of category	% of total	Relativity	Average		
7	GDD	**Mileage**							
8	no	low	952	9.612%	0.639%	1.2296	0.0485		
9		med.	7571	76.444%	5.080%	1.2296	0.0884		
10		high	1381	13.944%	0.927%	1.2296	0.0868		
11		average	9904	100.000%	6.646%	1.2296	0.0817		
12									
13	yes	low	23185	16.665%	15.558%	0.9837	0.9449		
14		med.	97759	70.269%	65.599%	0.9837	0.9130		
15		high	18178	13.066%	12.198%	0.9837	0.9142		
16		average	139122	100.000%	93.354%	0.9837	0.9183		
17									
18	average	low	24137	16.197%	16.197%		0.9934		
19		med.	105330	70.679%	70.679%		1.0013		
20		high	19559	13.125%	13.125%		1.0010		
21		average	149026	100.000%	100.000%		1.0000		
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	AA	AB	AC	AD	AE	AF	AG	AH	AI
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2									
3	*Determining part 2 of the prior relativities for Mileage*								
4									
5			Exposure			Adj. Indicated	Part of		
6			#	% of category	% of total	Relativity	Average		
7	GDD x Safe.	**Mileage**							
8	no / 0	low	571	9.306%	0.383%	-0.0405	-0.0010		
9		med.	4729	77.070%	3.173%	-0.0405	-0.0018		
10		high	836	13.625%	0.561%	-0.0405	-0.0017		
11		average	6136	100.000%	4.117%	-0.0405	-0.0017		
12									
13	no / 1	low	76	6.865%	0.051%	0.2305	0.0007		
14		med.	874	78.952%	0.586%	0.2305	0.0019		
15		high	157	14.182%	0.105%	0.2305	0.0019		
16		average	1107	100.000%	0.743%	0.2305	0.0017		
17									
18	no / 2+	low	306	11.495%	0.205%	0.2033	0.0026		
19		med.	1969	73.967%	1.321%	0.2033	0.0038		
20		high	388	14.576%	0.260%	0.2033	0.0040		
21		average	2662	100.000%	1.786%	0.2033	0.0036		
22									
23	yes / 0	low	20759	17.184%	13.930%	-0.0324	-0.0279		
24		med.	84691	70.108%	56.830%	-0.0324	-0.0260		
25		high	15351	12.708%	10.301%	-0.0324	-0.0254		
26		average	120801	100.000%	81.060%	-0.0324	-0.0263		
27									
28	yes / 1	low	2367	13.387%	1.588%	0.1844	0.0181		
29		med.	12594	71.229%	8.451%	0.1844	0.0221		
30		high	2720	15.384%	1.825%	0.1844	0.0256		
31		average	17681	100.000%	11.864%	0.1844	0.0219		
32									
33	yes / 2+	low	59	9.233%	0.040%	0.1627	0.0004		
34		med.	474	74.178%	0.318%	0.1627	0.0007		
35		high	107	16.745%	0.072%	0.1627	0.0009		
36		average	639	100.000%	0.429%	0.1627	0.0007		
37									
38	average	low	24138	16.197%	16.197%		-0.0070		
39		med.	105331	70.680%	70.680%		0.0006		
40		high	19559	13.125%	13.125%		0.0053		
41		average	149026	100.000%	100.000%		0.0000		
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	AJ	AK	AL	AM	AN	AO	AP	AQ	AR
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2									
3	*Determining part 1 of the prior relativities for Yrs. Lic.*								
4									
5				Exposure		Adj. Indicated	Part of		
6			#	% of category	% of total	Relativity	Average		
7	GDD	Yrs. Lic.							
8	no	low	7948	80.250%	5.333%	1.2296	0.4708		
9		med.	509	5.139%	0.342%	1.2296	0.0270		
10		high	1447	14.610%	0.971%	1.2296	0.0169		
11		average	9904	100.000%	6.646%	1.2296	0.0817		
12									
13	yes	low	12809	9.207%	8.595%	0.9837	0.6070		
14		med.	22670	16.295%	15.212%	0.9837	0.9621		
15		high	103643	74.498%	69.547%	0.9837	0.9701		
16		average	139122	100.000%	93.354%	0.9837	0.9183		
17									
18	average	low	20757	13.928%	13.928%		1.0778		
19		med.	23179	15.554%	15.554%		0.9891		
20		high	105090	70.518%	70.518%		0.9870		
21		average	149026	100.000%	100.000%		1.0000		
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	AS	AT	AU	AV	AW	AX	AY	AZ	BA
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2									
3	*Determining part 2 of the prior relativities for Yrs. Lic.*								
4									
5			Exposure			Adj. Indicated	Part of		
6			#	% of category	% of total	Relativity	Average		
7	GDD x Safe.	Yrs. Lic.							
8	no / 0	low	6136	100.000%	4.117%	-0.0405	-0.0120		
9		med.	0	0.000%	0.000%	-0.0405	0.0000		
10		high	0	0.000%	0.000%	-0.0405	0.0000		
11		average	6136	100.000%	4.117%	-0.0405	-0.0017		
12									
13	no / 1	low	1107	100.000%	0.743%	0.2305	0.0123		
14		med.	0	0.000%	0.000%	0.2305	0.0000		
15		high	0	0.000%	0.000%	0.2305	0.0000		
16		average	1107	100.000%	0.743%	0.2305	0.0017		
17									
18	no / 2+	low	706	26.521%	0.474%	0.2033	0.0069		
19		med.	509	19.121%	0.342%	0.2033	0.0045		
20		high	1447	54.358%	0.971%	0.2033	0.0028		
21		average	2662	100.000%	1.786%	0.2033	0.0036		
22									
23	yes / 0	low	10449	8.650%	7.012%	-0.0324	-0.0163		
24		med.	19049	15.769%	12.782%	-0.0324	-0.0266		
25		high	91303	75.581%	61.266%	-0.0324	-0.0281		
26		average	120801	100.000%	81.060%	-0.0324	-0.0263		
27									
28	yes / 1	low	2224	12.578%	1.492%	0.1844	0.0198		
29		med.	3480	19.682%	2.335%	0.1844	0.0277		
30		high	11978	67.745%	8.038%	0.1844	0.0210		
31		average	17681	100.000%	11.864%	0.1844	0.0219		
32									
33	yes / 2+	low	136	21.283%	0.091%	0.1627	0.0011		
34		med.	142	22.222%	0.095%	0.1627	0.0010		
35		high	362	56.651%	0.243%	0.1627	0.0006		
36		average	639	100.000%	0.429%	0.1627	0.0007		
37									
38	average	low	20758	13.929%	13.929%		0.0118		
39		med.	23180	15.554%	15.554%		0.0065		
40		high	105090	70.518%	70.518%		-0.0038		
41		average	149026	100.000%	100.000%		0.0000		
42									
43									
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	BB	BC	BD	BE	BF	BG	BH	BI	BJ
1									
2									
3	*Determining part 3 of the prior relativities for Yrs. Lic.*								
4									
5			Exposure			Adj. Indicated	Part of		
6			#	% of category	% of total	Relativity	Average		
7	GDD x Mile.	Yrs. Lic.							
8	no / low	low	694	72.899%	0.466%	-0.1564	-0.0052		
9		med.	30	3.151%	0.020%	-0.1564	-0.0002		
10		high	229	24.055%	0.154%	-0.1564	-0.0003		
11		average	952	100.000%	0.639%	-0.1564	-0.0010		
12									
13	no / med.	low	6155	81.297%	4.130%	-0.0405	-0.0120		
14		med.	388	5.125%	0.260%	-0.0405	-0.0007		
15		high	1028	13.578%	0.690%	-0.0405	-0.0004		
16		average	7571	100.000%	5.080%	-0.0405	-0.0021		
17									
18	no / high	low	1099	79.580%	0.737%	0.4098	0.0217		
19		med.	91	6.589%	0.061%	0.4098	0.0016		
20		high	190	13.758%	0.127%	0.4098	0.0007		
21		average	1381	100.000%	0.927%	0.4098	0.0038		
22									
23	yes / low	low	820	3.537%	0.550%	-0.1251	-0.0049		
24		med.	1800	7.764%	1.208%	-0.1251	-0.0097		
25		high	20566	88.704%	13.800%	-0.1251	-0.0245		
26		average	23185	100.000%	15.558%	-0.1251	-0.0195		
27									
28	yes / med.	low	9985	10.214%	6.700%	-0.0324	-0.0156		
29		med.	16834	17.220%	11.296%	-0.0324	-0.0235		
30		high	70941	72.567%	47.603%	-0.0324	-0.0219		
31		average	97759	100.000%	65.599%	-0.0324	-0.0213		
32									
33	yes / high	low	2005	11.030%	1.345%	0.3278	0.0317		
34		med.	4037	22.208%	2.709%	0.3278	0.0571		
35		high	12136	66.762%	8.144%	0.3278	0.0379		
36		average	18178	100.000%	12.198%	0.3278	0.0400		
37									
38	average	low	20758	13.929%	13.929%		0.0156		
39		med.	23180	15.554%	15.554%		0.0246		
40		high	105090	70.518%	70.518%		-0.0085		
41		average	149026	100.000%	100.000%		0.0000		
42									
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56									

	A	B	C	D	E	F
1	D. Sequen					
2	Additive M					
3						
4						
5			Unadjusted	Unadjusted	Average	Adjusted
6		Categories	Average Loss	dicated Relativity	PRFPF	ted Relativity
7	Step 1.					
8	GDD	no	288.999093	=C8/C$10	0	=1/(1 - (0.2 *
9		yes	145.519204	=C9/C$10	0	=0.8 * F8
10		average	155.054756	=C10/C$10	0	=(D10-E10)
11						
12	Step 2.					
13	Safety	0	149.280347	=(C13/C$16)-1	=O18-1	=D13-E13
14	Record	1	183.785927	=(C14/C$16)-1	=O19-1	=D14-E14
15		2+	213.576692	=(C15/C$16)-1	=O20-1	=D15-E15
16		average	155.054756	=(C16/C$16)-1	=O21-1	=D16-E16
17						
18	Step 3.					
19	Mileage	low	133.345152	=(C19/C$22)-1	=(X18-1)+AG38	=D19-E19
20		medium	150.2434	=(C20/C$22)-1	=(X19-1)+AG39	=D20-E20
21		high	207.758208	=(C21/C$22)-1	=(X20-1)+AG40	=D21-E21
22		average	155.054756	=(C22/C$22)-1	=(X21-1)+AG41	=D22-E22
23						
24	Step 4.					
25	Years	0 - 7	248.167142	=(C25/C$28)-1	=(AP18-1)+AY38+BH38	=D25-E25
26	Licensed	8 - 14	159.71851	=(C26/C$28)-1	=(AP19-1)+AY39+BH39	=D26-E26
27		15 +	135.634746	=(C27/C$28)-1	=(AP20-1)+AY40+BH40	=D27-E27
28		average	155.054756	=(C28/C$28)-1	=(AP21-1)+AY41+BH41	=D28-E28
29						
30						
31	NOTES:					
32	Relativ					
33	qualifi					
34	equati					
35		z = the relati				
36		0.8 * z = the				
37		R = the relat				
38		x = the % of				
39						
40				(R)	(z)	(0.8 * z)
41	Factor:	Categories:	% qualified for GDD	j. Indicated Relativity	Rel. if(GDD = no)	el. if(GDD = yes)
42	Safety	0	=K91/(K88+K91)	=F13	=D42/(1-(0.2*C42))	=0.8*E42
43	Record	1	=K92/(K89+K92)	=F14	=D43/(1-(0.2*C43))	=0.8*E43
44		2+	=K93/(K90+K93)	=F15	=D44/(1-(0.2*C44))	=0.8*E44
45		average	=SUM(K91:K93)/K94	=F16		
46						
47	Mileage	low	=T91/(T88+T91)	=F19	=D47/(1-(0.2*C47))	=0.8*E47
48		medium	=T92/(T89+T92)	=F20	=D48/(1-(0.2*C48))	=0.8*E48
49		high	=T93/(T90+T93)	=F21	=D49/(1-(0.2*C49))	=0.8*E49
50		average	=SUM(T91:T93)/T94	=F22		
51						
52	Years	0 - 7	=AL91/(AL88+AL91)	=F25	=D52/(1-(0.2*C52))	=0.8*E52
53	Licensed	8 - 14	=AL92/(AL89+AL92)	=F26	=D53/(1-(0.2*C53))	=0.8*E53
54		15 +	=AL93/(AL90+AL93)	=F27	=D54/(1-(0.2*C54))	=0.8*E54
55		average	=SUM(AL91:AL93)/AL94	=F28		
56						

	I	J	K	L	M	N	O	P
1								
2								
3	*Determi*							
4								
5				Exposure		j. Indicated	Part of	
6			#	% of category	% of total	Relativity	Average	
7	GDD	**Safety**						
8	no	0	6136	=K8/K$11	=K8/K$21	=$F$8	=(M8/M$18)*N8	
9		1	1107	=K9/K$11	=K9/K$21	=$F$8	=(M9/M$19)*N9	
10		2+	2662	=K10/K$11	=K10/K$21	=$F$8	=(M10/M$20)*N10	
11		average	9904	=K11/K$11	=K11/K$21	=$F$8	=(M11/M$21)*N11	
12								
13	yes	0	120801	=K13/K$16	=K13/K$21	=$F$9	=(M13/M$18)*N13	
14		1	17681	=K14/K$16	=K14/K$21	=$F$9	=(M14/M$19)*N14	
15		2+	639	=K15/K$16	=K15/K$21	=$F$9	=(M15/M$20)*N15	
16		average	139122	=K16/K$16	=K16/K$21	=$F$9	=(M16/M$21)*N16	
17								
18	average	0	=K8+K13	=K18/K$21	=K18/K$21		=O8+O13	
19		1	=K9+K14	=K19/K$21	=K19/K$21		=O9+O14	
20		2+	=K10+K15	=K20/K$21	=K20/K$21		=O10+O15	
21		average	=K11+K16	=K21/K$21	=K21/K$21		=O11+O16	
22								

	R	S	T	U	V	W	X	Y
1								
2								
3	*Determi*							
4								
5				Exposure		Indicated	Part of	
6			#	% of category	% of total	Relativity	Average	
7	GDD	**Mileage**						
8	no	low	952	=T8/T$11	=T8/T$21	=$F$8	=(V8/V$18)*W8	
9		med.	7571	=T9/T$11	=T9/T$21	=$F$8	=(V9/V$19)*W9	
10		high	1381	=T10/T$11	=T10/T$21	=$F$8	=(V10/V$20)*W10	
11		average	=SUM(T8:T10)	=T11/T$11	=T11/T$21	=$F$8	=(V11/V$21)*W11	
12								
13	yes	low	23185	=T13/T$16	=T13/T$21	=$F$9	=(V13/V$18)*W13	
14		med.	97759	=T14/T$16	=T14/T$21	=$F$9	=(V14/V$19)*W14	
15		high	18178	=T15/T$16	=T15/T$21	=$F$9	=(V15/V$20)*W15	
16		average	=SUM(T13:T15)	=T16/T$16	=T16/T$21	=$F$9	=(V16/V$21)*W16	
17								
18	average	low	=T8+T13	=T18/T$21	=T18/T$21		=X8+X13	
19		med.	=T9+T14	=T19/T$21	=T19/T$21		=X9+X14	
20		high	=T10+T15	=T20/T$21	=T20/T$21		=X10+X15	
21		average	=T11+T16	=T21/T$21	=T21/T$21		=X11+X16	
22								

	AA	AB	AC	AD	AE	AF	AG	AH
1								
2								
3	*Determi*							
4								
5				Exposure		j. Indicated	Part of	
6			#	% of category	% of total	Relativity	Average	
7	GDD x Safe.	**Mileage**						
8	no / 0	low	571	=AC8/AC$11	=AC8/AC$41	=$E$42	=(AE8/AE$38)*AF8	
9		med.	4729	=AC9/AC$11	=AC9/AC$41	=$E$42	=(AE9/AE$39)*AF9	
10		high	836	=AC10/AC$11	=AC10/AC$41	=$E$42	=(AE10/AE$40)*AF10	
11		average	6136	=AC11/AC$11	=AC11/AC$41	=$E$42	=(AE11/AE$41)*AF11	
12								
13	no / 1	low	76	=AC13/AC$16	=AC13/AC$41	=$E$43	=(AE13/AE$38)*AF13	
14		med.	874	=AC14/AC$16	=AC14/AC$41	=$E$43	=(AE14/AE$39)*AF14	
15		high	157	=AC15/AC$16	=AC15/AC$41	=$E$43	=(AE15/AE$40)*AF15	
16		average	1107	=AC16/AC$16	=AC16/AC$41	=$E$43	=(AE16/AE$41)*AF16	
17								
18	no / 2+	low	306	=AC18/AC$21	=AC18/AC$41	=$E$44	=(AE18/AE$38)*AF18	
19		med.	1969	=AC19/AC$21	=AC19/AC$41	=$E$44	=(AE19/AE$39)*AF19	
20		high	388	=AC20/AC$21	=AC20/AC$41	=$E$44	=(AE20/AE$40)*AF20	
21		average	2662	=AC21/AC$21	=AC21/AC$41	=$E$44	=(AE21/AE$41)*AF21	
22								
23	yes / 0	low	20759	=AC23/AC$26	=AC23/AC$41	=$F$42	=(AE23/AE$38)*AF23	
24		med.	84691	=AC24/AC$26	=AC24/AC$41	=$F$42	=(AE24/AE$39)*AF24	
25		high	15351	=AC25/AC$26	=AC25/AC$41	=$F$42	=(AE25/AE$40)*AF25	
26		average	120801	=AC26/AC$26	=AC26/AC$41	=$F$42	=(AE26/AE$41)*AF26	
27								
28	yes / 1	low	2367	=AC28/AC$31	=AC28/AC$41	=$F$43	=(AE28/AE$38)*AF28	
29		med.	12594	=AC29/AC$31	=AC29/AC$41	=$F$43	=(AE29/AE$39)*AF29	
30		high	2720	=AC30/AC$31	=AC30/AC$41	=$F$43	=(AE30/AE$40)*AF30	
31		average	17681	=AC31/AC$31	=AC31/AC$41	=$F$43	=(AE31/AE$41)*AF31	
32								
33	yes / 2+	low	59	=AC33/AC$36	=AC33/AC$41	=$F$44	=(AE33/AE$38)*AF33	
34		med.	474	=AC34/AC$36	=AC34/AC$41	=$F$44	=(AE34/AE$39)*AF34	
35		high	107	=AC35/AC$36	=AC35/AC$41	=$F$44	=(AE35/AE$40)*AF35	
36		average	639	=AC36/AC$36	=AC36/AC$41	=$F$44	=(AE36/AE$41)*AF36	
37								
38	average	low	=AC8+AC1	=AC38/AC$41	=AC38/AC$41		=AG8+AG13+AG18+AG23+AG28+AG33	
39		med.	=AC9+AC1	=AC39/AC$41	=AC39/AC$41		=AG9+AG14+AG19+AG24+AG29+AG34	
40		high	=AC10+AC	=AC40/AC$41	=AC40/AC$41		=AG10+AG15+AG20+AG25+AG30+AG35	
41		average	=AC11+AC	=AC41/AC$41	=AC41/AC$41		=AG11+AG16+AG21+AG26+AG31+AG36	
42								

	AJ	AK	AL	AM	AN	AO	AP	AQ
1								
2								
3	*Determi*							
4								
5				Exposure		. Indicated	Part of	
6			#	% of category	% of total	Relativity	Average	
7	GDD	Yrs. Lic.						
8	no	low	7948	=AL8/AL$11	=AL8/AL$21	=$F$8	=(AN8/AN$18)*AO8	
9		med.	509	=AL9/AL$11	=AL9/AL$21	=$F$8	=(AN9/AN$19)*AO9	
10		high	1447	=AL10/AL$11	=AL10/AL$21	=$F$8	=(AN10/AN$20)*AO10	
11		average	=SUM(AL8:AL10)	=AL11/AL$11	=AL11/AL$21	=$F$8	=(AN11/AN$21)*AO11	
12								
13	yes	low	12809	=AL13/AL$16	=AL13/AL$21	=$F$9	=(AN13/AN$18)*AO13	
14		med.	22670	=AL14/AL$16	=AL14/AL$21	=$F$9	=(AN14/AN$19)*AO14	
15		high	103643	=AL15/AL$16	=AL15/AL$21	=$F$9	=(AN15/AN$20)*AO15	
16		average	=SUM(AL13:AL15)	=AL16/AL$16	=AL16/AL$21	=$F$9	=(AN16/AN$21)*AO16	
17								
18	average	low	=AL8+AL13	=AL18/AL$21	=AL18/AL$21		=AP8+AP13	
19		med.	=AL9+AL14	=AL19/AL$21	=AL19/AL$21		=AP9+AP14	
20		high	=AL10+AL15	=AL20/AL$21	=AL20/AL$21		=AP10+AP15	
21		average	=AL11+AL16	=AL21/AL$21	=AL21/AL$21		=AP11+AP16	
22								