Fire Protection Classifications of Homeowners Insurance

by William J. VonSeggern, FCAS
Judith M. Feldmeier, ACAS
Elizabeth A. Wentzien, and
Sarah J. Billings

FIRE PROTECTION CLASSIFICATIONS FOR HOMEOWNERS INSURANCE

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Abstract

For many years the Insurance Services Office (ISO) has classified the fire protection offered by communities for all but the largest cities based upon a complex engineering study of communities' fire departments, water pressure and availability, and communications facilities. These protection classes are used in making rates for homeowners insurance and commercial property insurance. With regard to homeowners insurance, this classification system is effective in distinguishing protected from unprotected communities, and the loss experience is consistent with those results. However, among protected communities the ISO protection classes appear to be less effective at grouping communities in appropriate classes consistent with loss experience.

This paper introduces a methodology which performs the assignment of protection classes and the determination of protection class relativities in one step. This methodology uses actual homeowners experience in conjunction with engineering studies to determine protection class assignments. In using this method, a concept called "partial loss ratio" will be introduced. The partial loss ratio utilizes fire losses with the total adjusted homeowners insurance premium to derive a measure of fire loss experience. It is this experience that is used to develop protection classes and protection class relativities.

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Introduction

When calculating rates for homeowners insurance, most insurers use ISO fire protection classes to partition their experience into homogeneous groupings for analysis. Some insurers modify the classes to include areas in different protection classes based on slightly different criteria than those used by ISO. Generally these differences involve classifying parts of unprotected communities into protection classes 6 or lower based on some company-specific guidelines. Insurers then apply standard ratemaking methodology to their homeowners experience in order to determine protection class rate relativities.

This paper develops a methodology utilizing loss experience by cause of loss in the assignment of communities to protection classes and in the development of the resulting relativities. This will be done by introducing two concepts, the "partial loss ratio" and the "fire adjusted total loss ratio."

Using these concepts, the paper will then develop an enhanced methodology for better assigning medium and large communities to protection classes utilizing their own fire experience as well as ISO engineering studies. Properly categorized, this experience will be used to assign classes and determine rate relativities for those classes simultaneously.

Finally, we will discuss some potential public policy benefits of this methodology and further uses that may be possible.

Fire Protection Classes

ISO has developed a complex system to evaluate the ability of communities to protect their residents and businesses from damage caused by fire. This system is known as the Fire Suppression Rating Schedule. The system measures three factors:

1. The equipment available to and the training of the fire department in the community,
2. The availability of water of sufficient pressure to extinguish a fire, and
3. The quality and sufficiency of communications equipment.

ISO staff visit a community and its fire department to assess these three factors and assign points to the community based upon specific aspects of each. For example, a certain number of points is assigned to the number of phone lines entering into the dispatch system depending on a community's population. Points are also assigned to reflect the number and quality of fire equipment such as pumper and ladder trucks available to the community. Additional points are determined by measuring sustained water pressure and flow through the hydrant system.

Finally, ISO calculates a point total which is utilized to assign a protection class code to the community. This protection class is assigned based on a ten point scale, with 1 being the most protected community and 10 being a community with virtually no fire protection.

For a number of years there has been one major exception to this classification system for homeowners insurance. Communities with a population of more than 250,000 are known as statistically-rated communities. Statistically-rated communities are not assigned a formula protection class for homeowners insurance. Rather, it is assumed that a statistically-rated community will automatically reflect in its rates the fire protection that is available to its residents. Statistically-rated communities are often assigned unique protection class and territorial codes.

These cities have rates that reflect their own loss experience and are not necessarily subject to the fire protection class system.

It is not always apparent which communities are statistically-rated. For example, in Michigan the only city large enough to be statistically-rated is Detroit. The rate manual for virtually any homeowners insurer in Michigan would assign a protection class code of 2 to Detroit. Further review of the manual would reveal that no other city in Michigan has a protection class code of 2. If one were not aware that Detroit is a statistically-rated community, one might assume that Detroit has the best fire protection available in the state of Michigan. While it is true that Detroit has a fine fire department, it does not automatically follow that Detroiters enjoy the best fire protection in Michigan as measured by the ISO classification system, since the 2 is not derived from that system.

Some Traditional Concepts

Homeowners insurance was originally offered as a combination of several different coverages including fire, allied lines and personal liability. These coverages were priced separately or as optional endorsements. In the 1950's, insurers began marketing homeowners insurance with an indivisible premium, combining the coverages of all three of the above products and providing even broader protection. The homeowners combined product was offered at a price lower than the sum of the predecessor coverages.

This lower price was made possible by a reduction in adverse selection. Because insureds no longer had the option of rejecting allied lines, for example, insurers were not providing coverage only to insureds with a perceived need for the coverage and at greater risk of a loss. Prospective insureds with low risk of a loss now also purchased the coverage in its combined form. Further, homeowners insurance was offered with an indivisible premium making it impossible for insurers or insureds to know exactly what premium was responsible for which losses.

The Partial Loss Ratio and Fire Adjusted Total Loss Ratio

We need a mechanism for dealing with the reality that homeowners insurance is written for an indivisible premium and a methodology to determine which part of the premium is supposed to pay for fire losses, for theft losses, etc.

In order to address that problem, some new ratios will be defined. The first of these is the partial loss ratio. Let us define the fire partial loss ratio as

(1) Fire partial loss ratio (FPLR) = (fire losses)/(total premium).

Similarly, we can define partial loss ratios for theft, liability and other causes of loss as:

(2) Theft partial loss ratio (TPLR) = (theft losses)/(total premium),

(3) Liability partial loss ratio (LPLR) = (liability losses)/(total premium), and

(4) Other partial loss ratio (OPLR) = (other losses)/(total premium).

Since all of these partial loss ratios have the same denominator they can be added together, resulting in the total loss ratio as we traditionally understand it

(5) Total loss ratio (TLR) = FPLR + TPLR + LPLR + OPLR.

In this paper, we are only concerned with fire and non-fire losses. We will define the non-fire partial loss ratio (NPLR) as follows:

(6) NPLR = TPLR + LPLR + OPLR.

Equation (5) then becomes:

(7) TLR = FPLR + NPLR.

In addition, we can define these loss ratios for protection classes:

$FPLR_{PC_i}$ is the fire partial loss ratio for protection class i, for i = 1, 2,...., 10.

The premium weighted average of the total loss ratios for each of the protection classes is the statewide total loss ratio:

(8) $TLR_{S/W}$ = Weighted Average(TLR_{PC_1}, TLR_{PC_2}, ..., $TLR_{PC_{10}}$).

Similarly, the statewide fire partial loss ratio is a weighted average of the fire partial loss ratios for each protection class:

(9) $FPLR_{S/W}$ = Weighted Average($FPLR_{PC_1}$,$FPLR_{PC_2}$,...,$FPLR_{PC_{10}}$).

and the statewide partial loss ratios for non-fire perils can be shown to be the weighted average of the partial loss ratios for each protection class:

(10) $NPLR_{S/W}$ = Weighted Average($NPLR_{PC_1}$,$NPLR_{PC_2}$,...,$NPLR_{PC_{10}}$).

Now we can define the Fire Adjusted Total Loss Ratio (FATLR). The FATLR is the loss ratio to be utilized in determining the rate relativities for a protection class or community by including only its own fire experience in the calculation. This is done by adjusting the loss ratio to exclude the effect of other causes of loss on the calculation.

When rate relativities are calculated they are increased or decreased until the resulting loss ratio for each classification is the same. Using this principle we need to adjust the loss ratios for each protection class so that losses from causes other than fire do not affect the calculation of the rate relativity. We do this by assuming that

(11) $NPLR_{PC_i} = NPLR_{PC_j} = NPLR_{S/W}$ for i, j = 1,2,....,10.

However, for fire losses we include the actual partial loss ratio for the protection class. When these are added together we have the $FATLR_{PC_i}$ for each protection class.

(12) $FATLR_{PC_i} = FPLR_{PC_i} + NPLR_{S/W}$ for i = 1,2,....,10.

For the statewide total loss ratio, the following equation holds:

(13) $TLR_{S/W}$ = Weighted average($FATLR_{PC_1}$,$FATLR_{PC_2}$,...,$FATLR_{PC_{10}}$).

Pure Premium Approach

We have created loss ratios with different premiums in their denominators. These premiums reflect rating factors which may not be uniform across protection class. In fact, they are not uniform, so adjustments will be required. To introduce these adjustments, we will begin with a simple pure premium example (Table 1). Consider a state with only one territory, two protection classes and no other rating factors. Pure premiums and exposures are available.

Table 1

Protection Class	Exposures	Fire Pure Premium	Non-fire Pure Premium	Total Pure Premium
1	1	F_1=50	N_1=100	T_1=150
2	1	F_2=100	N_2=100	T_2=200
Statewide	2	$F_{S/W}$ =75	$N_{S/W}$ =100	$T_{S/W}$ =175
Proportion of Statewide		43%	57%	100%

In this case, the only difference between the protection classes is the fire losses, and they are clearly doubled in protection class 2 as compared to protection class 1. We can compare the total-protection class 2 pure premium to the total statewide average and calculate a relativity of 1.143 (200/175). Algebraically, this is expressed

(14) $T_2/T_{S/W} = (F_2+N_2)/(F_{S/W}+N_{S/W})$.

In this example

(15) $N_{S/W} = N_1 = N_2$.

Substituting into Equation (14) we have

(16) $T_2/T_{S/W} = (F_2+N_{S/W})/(F_{S/W} +N_{S/W}) = F_2/(F_{S/W}+N_{S/W}) + N_{S/W}/(F_{S/W} +N_{S/W})$.

Next, let us illustrate what happens when we assume Equation (15) to be true no matter what differences in other causes of loss actually do exist. Returning to our numerical example, let us change the non-fire pure premium in each protection class (Table 2). For example, the non-fire pure premium differences could result from each protection class being located in a unique territory. We will continue to hold the proportion of a statewide pure premium due to each cause of loss constant, since a change would affect the result.

Table 2

Protection Class	Exposures	Fire Pure Premium	Non-fire Pure Premium	Total Pure Premium
1	1	F_1=50	N_1=50	T_1=100
2	1	F_2=100	N_2=150	T_2=250
Statewide	2	$F_{S/W}$ =75	$N_{S/W}$ =100	$T_{S/W}$ =175
Proportion of Statewide		43%	57%	100%

Using Equation (16) which compares protection class 2 to statewide, we again calculate a relativity of (100+100)/175 = 1.143. Clearly, this calculation does not represent the complete difference in total pure premium for protection class 2. That relativity would be 250/175=1.429. Rather, it reflects only the difference in fire results between protection classes.

We now expand the example to a two territory, two protection class situation (Table 3). The formulae still hold, but the results differ by territory.

Table 3

Protection Class	Exposures	Fire Pure Premium	Non-fire Pure Premium	Total Pure Premium
Territory A				
1	1	F_{A1}=50	N_{A1}=50	T_{A1}=100
2	1	F_{A2}=100	N_{A2}=50	T_{A2}=150
Total	2	$F_{A\bullet}$=75	$N_{A\bullet}$=50	$T_{A\bullet}$=125
Territory B				
1	1	F_{B1}=50	N_{B1}=150	T_{B1}=200
2	1	F_{B2}=100	N_{B2}=150	T_{B2}=250
Total	2	$F_{B\bullet}$=75	$N_{B\bullet}$=150	$T_{B\bullet}$=225
All territories				
1	2	$F_{\bullet 1}$=50	$N_{\bullet 1}$=100	$T_{\bullet 1}$=150
2	2	$F_{\bullet 2}$=100	$N_{\bullet 2}$=100	$T_{\bullet 2}$=200
Statewide	4	$F_{\bullet\bullet}$=75	$N_{\bullet\bullet}$=100	$T_{\bullet\bullet}$=175
Proportion of Statewide		43%	57%	100%

For example, in territory A the relativity between protection class 2 and the statewide total is (100+50)/175 = 0.857. In territory B the relativity is (100+150)/175 = 1.429. Statewide, the figure is (100+100)/175 = 1.143.

We have demonstrated that this methodology produces consistent statewide protection class relativities using pure premiums and that other rating factors (territory, in our example) affect the results. By using the statewide non-fire pure premiums to determine protection class relativities, we were able to adjust for only fire differences in protection class. The statewide protection class 2 relativity of 1.143 was constant across examples:

$[(F_{A2} + N_{\bullet\bullet}) / T_{\bullet\bullet} = (F_{B2} + N_{\bullet\bullet}) / T_{\bullet\bullet} = (100+100) / 175 = 1.143]$.

Transition to Loss Ratio

We wish to make the transition from pure premium to loss ratio for Equation (16). Again, we will restrict ourselves to two rating variables, territory and protection class. We need to review the relationship between exposures and premiums:

(17) Premiums in protection class 2 = Exposure in protection class 2*base rate*protection class 2 relativity*average territorial relativity in protection class 2.

Therefore,

(18) Exposures in protection class 2 = premiums in protection class 2/(base rate*protection class 2 relativity*average territorial relativity in protection class 2).

Each pure premium term in Equation (16) can now be rewritten. First,

(19) F_2 = fire losses in protection class 2/exposures in protection class 2 = fire losses in protection class 2/[premiums in protection class 2/(base rate*protection class 2 relativity*average territorial relativity in protection class 2)].

Using $FPLR_{PC_2}$ as defined in Equation (1),

(20) $F_2 = FPLR_{PC_2}$*base rate*protection class 2 relativity*average territorial relativity in protection class 2.

Now returning to Equation (16), we have

(21) $T_2/T_{S/W}$ = [$FPLR_{PC_2}$∗(base rate∗protection class 2 relativity∗average territorial relativity in protection class 2) + $NPLR_{S/W}$∗(base rate∗statewide average protection class relativity∗statewide average territorial relativity)]/[TLR∗(base rate∗statewide average protection class relativity∗statewide average territorial relativity)].

The *base rate* term cancels and we are left with

(22) $T_2/T_{S/W}$ = [$FPLR_{PC_2}$∗(protection class 2 relativity∗average territorial relativity in protection class 2) + $NPLR_{S/W}$∗(statewide average protection class relativity∗statewide average territorial relativity)]/[TLR∗(statewide average protection class relativity∗statewide average territorial relativity)].

We have shown that the use of partial loss ratios as defined above is equivalent to using adjusted pure premiums for calculating protection class relativities in our two variable example.

However, homeowners ratemaking encompasses more than our two rating variables, territory and protection class. It also considers amount of insurance, security devices, age of dwelling, age of insured, construction and a myriad of other possible classifications depending on jurisdiction. Utilizing pure premiums without adjusting for differences in each of these factors will lead to double counting and inaccurate relativities. For example, if the protection classes in Table 3 had differing underlying amounts of insurance as well as different loss experience, one would need to adjust for the differences in amount of insurance before calculating the appropriate protection class relativities. The adjustment would include dividing each protection class pure premium and the statewide pure premium by the average amount of insurance relativities in effect for those classes. Conversely, using loss ratios adjusted to a base territory and protection class will achieve the same result as using adjusted pure premium. This, of course, could be done for any and all rating factors.

Testing Protection Classes in Michigan

One of the premises of this paper is that the ISO Fire Suppression Rating Schedule is effective at separating protected from unprotected communities, but less effective at predicting the loss results in protected communities. Using both the traditional methodologies and the one just developed we can test that presumption, utilizing Michigan homeowners data.

We can divide the ISO protection classes into four categories:

1. Statistically-rated community - This is coded as protection class 2 and represents the city of Detroit. Since Detroit has a population of more than 250,000 it is not evaluated by ISO and is statistically-rated.
2. "Protected" communities - Protection classes 3-6 are included in this group which consists of all of the larger communities and most of the metropolitan areas in the state.
3. "Less protected" communities - These communities are assigned protection classes 7, 8 and 9 and include a number of developing suburban communities.
4. "Unprotected" communities - This is protection class 10 and includes many rural areas.

Exhibit 1 shows the TLR's, FPLR's, and FATLR's by protection class. These have been adjusted to a common territorial and protection class level as described above. The loss ratios reveal differences among the four categories cited above. They also distinguish among the less protected and unprotected classes. However, these loss ratios are not as effective in differentiating among the protected classes (3-6), where higher protection classes do not translate to higher loss ratios.

Assignment of Fire Protection Classes and Relativities by Community

We have argued that the ISO methodology is less effective at distinguishing among protected communities. Using the previously defined FATLR's, we will develop a credibility enhanced procedure to assign rate relativities for protected communities. This methodology will highlight distinctions among protected communities, thus measuring the efficacy of a community's fire protection using proprietary loss data.

Let us take the partial loss ratios defined earlier for protection classes and redefine them for individual communities:

$FPLR_{C_i}$ is the fire partial loss ratio for community i

and similarly for $NPLR_{C_i}$.

Equation (23) follows from Equation (12):

(23) $FATLR_{C_i} = FPLR_{C_i} + NPLR_{S/W}$ for i = community 1, 2,....

We can use this definition for all of the communities in the state. As with the protection classes, these loss ratios will average to the respective statewide loss ratios. In addition, all of the loss ratios for communities within a protection class will also average to the protection class loss ratios. However, for credibility reasons not all communities will be analyzed individually.

For each selected community, we need to calculate the FATLR. Premiums and losses by cause of loss are gathered for each community. Adjustments are completed as in Equation (22). The indicated relativity for each community is calculated as

(24) $Rel_{C_i} = [FATLR_{C_i} * Z + FATLR_{S/W} * (1-Z)] / FATLR_{S/W}$, where Z is the credibility of community i's experience.

Establishing a community's credibility is a significant issue in this methodology. We have found through practical experience that three rules have created relatively stable and sound results; however, other alternatives may be appropriate. The criteria we have used are as follows:

1. Only communities of 30,000 residents or more are included in the procedure;
2. As many years of data as are available (up to 10 years) are used;
3. The square root rule is used for partial credibility with a full credibility standard of 683 fire claims.

While these standards have been developed without theoretical study, especially with regard to the variation in claim severity, it does appear that these standards provide for reasonable results.

In addition, different complements of credibility might be appropriate. For example, Equation (24) might be amended to use a fire adjusted loss ratio for a whole protection class rather than $FATLR_{S/W}$. Or, a three-way credibility technique could be developed using the community, protection class and statewide FATLR's.

Returning to our analysis, we can rank each community and select protection class relativities by grouping the communities based on the indicated relativities from Equation (24). Exhibit 2 presents a sample analysis using fifteen communities in Michigan. On page 1, $FATLR_{C_i}$ was calculated and the indicated relativity was determined. On page 2, the communities were ranked and protection classes were assigned. In this example, protection classes 3-6 were divided into seven groups with relativities ranging from 0.90 to 1.10.

Other Relevant Issues

There is public policy value to this analysis, as well. With the ISO Fire Suppression Rating Schedule, communities are encouraged to engage in certain specific fire protection activities in order to achieve a lower fire protection class. However, this lower fire protection class may not yield better loss experience or lower rates. By performing this internal data analysis, insurance companies can report to communities and insureds on the benefit of the fire protection offered. Communities are then free to respond as they deem appropriate. For example, one community may invest in additional fire trucks. Another community may decide that better fire protection could be achieved by rehabilitating communities and developing stable neighborhoods rather than by hiring more firefighters and buying more trucks. Still another community may realize that brush fires or other unusual hazards are affecting them and provide unique or different solutions for their residents.

In addition, insurers may be able to adapt this methodology to other ratemaking classification analyses to produce more accurate rates and more understandable rating plans. For example, insurers could develop theft protection classes or water seepage districts by community. This would provide insurers with the data to support the differences in rates that many insureds and consumer groups regularly challenge. Public officials would also receive valuable information to guide improvements that would benefit the residents of their communities.

Conclusion

ISO fire protection classes which are utilized, at least as a starting point by most insurers, effectively distinguish between protected and unprotected communities. However, they are not sufficiently refined to provide accurate and appropriate distinctions among protected communities. This paper has presented a method for distinguishing among these protected communities using their fire experience. The new methodology also provides some public policy benefits. Finally, we have offered an additional tool for classification ratemaking.

Exhibit 1

Protection Class Data

Protection Class	Category	Total Loss Ratio	Fire Partial Loss Ratio	Fire Adjusted Total Loss Ratio
2	Statistically-rated	132.9%	54.5%	99.5%
3	Protected	88.1%	38.0%	83.1%
4	Protected	67.1%	24.4%	69.4%
5	Protected	55.0%	21.3%	66.3%
6	Protected	67.7%	27.9%	73.0%
7	Less Protected	68.2%	31.5%	76.5%
8	Less Protected	84.0%	41.8%	86.9%
9	Less Protected	106.1%	57.7%	102.7%
10	Unprotected	110.4%	65.4%	110.5%
Statewide		79.1%	34.1%	79.1%

All premiums are adjusted to a common territory and protection class. Loss ratios are adjusted to protect the proprietary nature of the data.

Protection Class by Community

City	ISO Protection Class	Fire Adjusted Total Loss Ratio	Credibility	Indicated Relativity
Community 1	3	65.6%	68.7%	1.043
Community 2	3	60.4%	58.9%	0.986
Community 3	4	48.5%	26.0%	0.944
Community 4	4	55.4%	47.9%	0.950
Community 5	4	66.2%	33.8%	1.024
Community 6	4	54.4%	64.0%	0.924
Community 7	4	51.2%	72.8%	0.875
Community 8	4	57.0%	100.0%	0.922
Community 9	5	64.6%	49.6%	1.023
Community 10	5	79.2%	61.7%	1.173
Community 11	5	60.1%	59.0%	0.983
Community 12	5	57.2%	82.2%	0.939
Community 13	5	65.3%	63.7%	1.037
Community 14	6	81.6%	43.3%	1.139
Community 15	6	49.9%	58.3%	0.887
Statewide		61.8%	100.0%	

All premiums are adjusted to a common territory and protection class. Loss ratios are adjusted to protect the proprietary nature of the data.

Protection Class by Community

City	ISO Protection Class	Indicated Relativity	Possible Selection
Community 7	4	0.875	0.900
Community 15	6	0.887	0.900
Community 8	4	0.922	0.925
Community 6	4	0.924	0.925
Community 12	5	0.939	0.925
Community 3	4	0.944	0.950
Community 4	4	0.950	0.950
Community 11	5	0.983	0.975
Community 2	3	0.986	0.975
Community 9	5	1.023	1.025
Community 5	4	1.024	1.025
Community 13	5	1.037	1.025
Community 1	3	1.043	1.050
Community 14	6	1.139	1.100
Community 10	5	1.173	1.100

All premiums are adjusted to a common territory and protection class. Loss ratios are adjusted to protect the proprietary nature of the data.