

### 3.1.0 Overview

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When we developed the fundamental insurance equation in Section 1, we noted that balance should be attained at the aggregate and individual risk levels. We learned how to determine rates that are appropriate in the aggregate in Section 2.6. In this section, we will focus on developing a balanced indication for individual risk or risk segments.

For very large risks with a significant amount of individual experience, insurers can utilize this experience to estimate the premium needed for a future policy term. However, for the majority of insurance products, this approach is impractical. Instead, they adopt a process called **classification ratemaking**, which is the process of grouping risks based on their similarity in loss potential and charging different manual rates to account for variations in their potential for losses.

Classification ratemaking involves two primary steps:

1. Identify the **rating variables**, which are risk factors that effectively segment risks into groups with similar expected loss experience. The various values of a rating variable are known as **levels**.
2. Determine the indicated rate differential relative to the base level for each level being priced. Rate differentials that are applied multiplicatively are referred to as **rate relativities**, while those that are applied additively are referred to as **additives**. A **class** is a group of insureds that belong to the same level for each of several rating variables.

In this subsection, we will start by discussing the importance of charging equitable rates. Then, we will look at the criteria for evaluating potential rating variables. Lastly, we will cover traditional univariate techniques used in classification ratemaking.

### 3.1.1 Importance of Equitable Rates

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Some may think the insurance company need not overly worry about individual rate equity as long as the rates are expected to meet the target profit at the aggregate level. However, in reality, ensuring equitable rates at the individual risk level is equally crucial.

To understand why it is important for companies to charge equitable rates, let's consider an example similar to the one in the source material. You can find the calculations in this [worksheet](#).

You are given:

- The insured population consists of 20,000 high-risk insureds and 20,000 low-risk insureds.
- High-risk insureds have a cost of \$600 per year, and low-risk insureds have a cost of \$400 per year.
- An insurance market consists of two companies: Insurer A and Insurer B.
- Insurer A and Insurer B each insure 10,000 high-risk insureds and 10,000 low-risk insureds.
- Insurer A implements a rating variable that recognizes the differences in costs of the different risks. As a result, Insurer A charges the high-risk insureds \$600 and the low-risk insureds \$400. Insurer B charges all risks \$500.
- All policies have an annual policy term. 10% of insureds shop at renewal and base the purchasing decision on price.

The original distribution of risks and the rates charged are summarized below:

Risk	True Expected Cost	Insurer A			Insurer B		
		Number of Risks	Charged Rate	Profit	Number of Risks	Charged Rate	Profit
Low-Risk	\$400	10,000	\$400	\$0	10,000	\$500	\$1,000,000
High-Risk	\$600	10,000	\$600	\$0	10,000	\$500	-\$1,000,000
Total	\$500	20,000	\$500	\$0	20,000	\$500	\$0

For the first policy year, the risks are evenly distributed between the two companies. Although the total profit for both companies is \$0, the breakdown of the profit is different for each company. Insurer A charges rates that are equitable to the costs of the risks, so the profit for each type of

risk is \$0. Insurer B, on the other hand, does not vary rates based on the cost of the risks. It overcharges the low-risk insureds and undercharges the high-risk insureds. As a result, it gains from the low-risk insureds and loses on the high-risk insureds. Since the profit from the low-risk insureds exactly offsets the loss on the high-risk insureds, the total profit for Insurer B is \$0.

At the beginning of Policy Year 2, 10% of the policyholders will compare the prices between the companies and choose the one that charges a lower rate. Since Insurer A charges a lower rate for low-risk insureds,  $10\% \times 10,000 = 1,000$  of the low-risk insureds will move from Insurer B to Insurer A. At the same time,  $10\% \times 10,000 = 1,000$  of the high-risk insureds will move from Insurer A to Insurer B because Insurer B charges a lower rate for high-risk insureds. Thus, the distribution of risks and profits for the second policy year is as follows:

Risk	True Expected Cost	Insurer A			Insurer B		
		Number of Risks	Charged Rate	Profit	Number of Risks	Charged Rate	Profit
Low-Risk	\$400	11,000	\$400	\$0	9,000	\$500	\$900,000
High-Risk	\$600	9,000	\$600	\$0	11,000	\$500	-\$1,100,000
Total	\$500	20,000	\$490	\$0	20,000	\$500	-\$200,000

Insurer A still has a \$0 total profit because the insurer charges the right rate for each class. Insurer B now has more high-risk insureds than low-risk insureds. The profit from overcharging the low-risk insureds is not sufficient to cover the losses from undercharging the high-risk insureds. As a result, Insurer B has a total loss of \$200,000. In order to break even, Insurer B must increase the rate from \$500 to \$510, the new average cost based on the new distribution.

$$\frac{9,000 \times \$400 + 11,000 \times \$600}{20,000} = \$510$$

This cycle will continue if Insurer B keeps charging all risks the same rate. The low-risk insureds will move to Insurer A, and the high-risk insureds will move to Insurer B. Insurer A will not have any profits or losses from this distributional shift because the company is charging equitable rates. Insurer B, however, will continue to charge an average rate based on the previous distribution, leading to a shortfall every year as the distribution changes. As a result, Insurer B will have to implement rate increases every year to address this shortfall.

The downward spiral that Insurer B is experiencing is known as **adverse selection**. The cycle will continue every year until Insurer B

1. begins to segment in a more refined manner,
2. becomes insolvent, or
3. specializes in insuring high-risk insureds only.

In contrast, insurer A is experiencing *favorable selection* since it identifies a characteristic that differentiates risk that its competitor is not recognizing. Insurer A chooses to implement a new rating variable based on the risk characteristic. Introducing a new rating variable and pricing it appropriately can lead to more equitable rates for a company. Consequently, the company may be able to write a segment of risks that were previously considered uninsurable or attract more lower-risk insureds at a profit. Over the long run, the company can expand its scope of insurable risks and generate profits from a broader range of policies.

If the company chooses not to or is not able to implement a new rating variable, it can continue charging the same rate and use the risk characteristic for other purposes, such as underwriting, marketing, and agency management. The action of using the risk characteristic to identify, attract, and select the lower-risk insureds that exist in the insured population is known as "*skimming the cream*." For example, instead of charging higher rates to drivers with a higher risk, an insurer can decide to reject these risks during the underwriting process and only approve the lower-risk drivers.

### Example 3.1.1.1 [CAS Exam 5 2008 Q29]

Company ABC and Company XYZ charge actuarially sound rates and have comparable rating structures. The insurance industry discovers a new rating characteristic that is an effective differentiator of prospective loss costs.

- (a) Explain the impact of this new characteristic on both companies assuming that Company ABC implements the new rating characteristic while maintaining the same average rate and that Company XYZ maintains its existing rating plan.
- (b) Assuming the regulators prohibit the implementation of the new rating characteristic, identify and briefly explain two ways the companies could still benefit from the new characteristic.

### Solution to (a)

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If Company ABC implements the new rating characteristic, it will charge a lower rate to the low-risk insureds and a higher rate to the high-risk insureds. As a result, there will be a distributional shift where the low-risk insureds will move from Company XYZ to Company ABC, and the high-risk insureds will move from Company ABC to Company XYZ. Since Company XYZ maintains its existing rating plan, the excess premium collected from the low-risk insureds is insufficient to cover the shortfall from the high-risk insureds. Consequently, Company XYZ will be unprofitable. In this scenario, Company XYZ is experiencing adverse selection while Company ABC is experiencing favorable selection.



## Solution to (b)

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The companies can use the rating characteristic to:

1. Focus marketing on lower-risk groups and limit exposure to higher-risk individuals.
2. Underwriting selectively, using the rating characteristic to focus on lower-risk insureds.
3. Companies may identify a proxy variable or set of variables that closely approximates the predictive value of the prohibited rating characteristic.



## Summary

To compete effectively over the long term, companies must ensure that their rates are appropriate both in aggregate and at the individual risk level. If a company fails to charge appropriate rates at the individual risk level while competitors do, it risks losing lower-risk insureds to other companies offering more favorable rates. This imbalance, if unaddressed, can lead to adverse selection.

### 3.1.2 Criteria for Evaluating Rating Variables

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The first step in classification ratemaking is to identify the rating variables that will be used to classify risks. The criteria for evaluating the appropriateness of rating variables can be grouped into four categories:

1. Statistical
2. Operational
3. Social
4. Legal

## Statistical Criteria

### 1. Statistical significance

The rating variable should be a statistically significant risk differentiator. This means that different levels of the rating variable should have different expected costs, and these differences in expected costs should be statistically significant and stable over time.

### 2. Homogeneity

The risks within the same level should have similar expected costs. A group of risks with materially different risk potentials should be further divided by adding more levels to an existing rating variable or by implementing new rating variables.

### 3. Credibility

Each level of a rating variable should be large and/or stable enough to allow a credible estimate of costs. Credibility can be increased by combining data or including additional relevant data.

When classifying risks into different groups, it is important to balance between homogeneity and credibility. The number of risks in a group should be large enough to ensure credibility but not too large to maintain the homogeneity among the risks in the group.

## Operational Criteria

## 1. Objective

The definitions of the levels within a rating variable should be clear, objective, and measurable. For example, in auto insurance, it might seem logical to use "adherence to traffic rules" as a rating variable. However, the variable is hard to measure and subject to personal biases. Thus, it is not a practical choice for a rating variable.

## 2. Inexpensive to administer

The cost to obtain the data needed to classify risks should not outweigh the potential benefit.

## 3. Verifiable

The levels of a rating variable should not be easily manipulated and should be easily verifiable.

# Social Criteria

## 1. Affordability

Insurance should be affordable for all risks, especially when the insurance is mandated by law, required by a third party, or essential for business operations. To increase affordability, insurers can introduce subsidies or offer less coverage to high-risk insureds.

## 2. Causality

A clear cause-and-effect relationship between a rating variable and expected losses will increase the social acceptability of the classification. For example, in auto insurance, the use of the insured's zip code as a rating variable is controversial because it lacks a direct causal link between where someone lives and their driving behavior or accident risk.

## 3. Controllability

Policyholders generally prefer to have some degree of control over the class to which they belong and the ability to influence the premium charged. For example, in property insurance, having a home security system installed in the insured property can lead to a reduction in premium as it indicates the insured's ability to mitigate theft risk. The insured has the option of whether or not to install one.

## 4. Privacy concerns

The rating variable used should not infringe on the privacy of the insureds.



## Industry Remarks

In practice, controllability often needs to be balanced by concerns of privacy. Policyholders often prefer to limit the amount of personal information shared with insurance companies. This explains why many individuals choose not to participate in telematics programs, which use devices to monitor driving behavior.

## Legal Criteria

Nearly all jurisdictions worldwide have laws and regulations pertaining to property and casualty insurance products.

In the United States, property and casualty insurance products are regulated at the state level. Each state has its own laws and regulations governing insurance pricing, with substantial variation from state to state and by type of product. Most states have statutes requiring insurance rates to be "not excessive, not inadequate, and not unfairly discriminatory." Additionally, some state statutes mandate that certain rates be "actuarially sound." The interpretation of these statutes by a state's executive branch can differ widely both across states and within a single state over time.

Some states have also issued regulations detailing permissible and impermissible practices in risk classification for various property and casualty insurance products. The rate classification system should be in compliance with applicable laws and regulations in each jurisdiction in which the company is writing business.

### Example 3.1.2.1 [CAS Exam 5 2008 Q28]

An insurance company wants to use color of car as a rating variable within its risk classification system.

- a. Identify two operational risk classification criteria and evaluate the variable "color of car" with respect to each criterion.
- b. Identify two social risk classification criteria and evaluate the variable "color of car" with respect to each criterion.



## Solution to (a)

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1. **Inexpensive to administer:** The color of a car can be easily obtained at a low cost, so this criterion is met.
2. **Verifiable:** The color of a car can be easily verifiable by requiring the insureds to submit proof, such as a picture of the car. Thus, this criterion is met.



## Solution to (b)

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1. **Controllability:** The insureds can control what color of car they buy. Thus, this criterion is met.
2. **Privacy:** The color of a car can be seen by anyone, so using this as a rating variable will not infringe on the privacy of the insureds.



## Coach's Remarks

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Note that they requested two criteria from each category. We selected two, but you could choose different ones.

For example, you might discuss causality as a social criterion, noting that people may not see how car color could affect accident rates.

On the exam, just select two criteria and provide a clear evaluation.

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## Actuarial Standard of Practice No. 12

The *Actuarial Standard of Practice (ASOP) No. 12*, titled "Risk Classification (for All Practice Areas)", provides guidance to actuaries when performing professional services with respect to designing, reviewing, or changing risk classification systems. The analysis of issues and recommended practices included in ASOP No. 12 are summarized below.

### CONSIDERATIONS IN THE SELECTION OF RISK CHARACTERISTICS

The following should be considered when selecting the risk characteristics that will be used in a risk classification system:

#### 1. Relationship of risk characteristics and expected outcomes

Select risk characteristics that are correlated to the expected outcomes.

#### 2. Causality

A cause-and-effect relationship between the selected risk characteristics and the expected outcome is desirable but unnecessary.

#### 3. Objectivity

Select risk characteristics that can be objectively determined. A risk characteristic is objectively determinable when it relies on easily verifiable and observable facts that are not prone to manipulation.

#### 4. Practicality

Select risk characteristics that are practical. This means that the cost, time, and effort needed to evaluate the risk characteristic is reasonable, the cost of administration is fair, and the use of the risk characteristic is generally accepted.

#### **5. Applicable law**

The selected risk characteristics should comply with applicable law.

#### **6. Industry practices**

The common industry practices should be taken into consideration when selecting the risk characteristics.

#### **7. Business practices**

Limitations created by business practices should be considered when selecting the risk characteristics.

### **CONSIDERATIONS IN ESTABLISHING RISK CLASSES**

The following should be considered when establishing risk classes in a risk classification system:

#### **1. Intended use**

The risk classes should be appropriate for their intended purposes.

#### **2. Actuarial considerations**

The risks in each risk class should be sufficiently homogeneous, which means that their expected outcomes should have comparable values. Meanwhile, the risk classes should be large enough to have sufficient credibility.

When establishing the risk classes, the actuary should balance between accuracy, efficiency, and minimizing the potential effects of adverse selection.

#### **3. Other considerations**

Other considerations include compliance with applicable law, industry practices, and limitations created by business practices.

#### **4. Reasonableness of results**

The results from the intended use of the risk classes should be reasonable, as well as consistent over time. We don't want to increase rates substantially only to reduce them in the next rate change.

## TESTING THE RISK CLASSIFICATION SYSTEM

Once a risk classification system has been established, it should be reviewed and tested to evaluate emerging experience and identify if a change is needed. The following should be considered when testing the risk classification system:

### 1. Effects of adverse selection

The potential effects of adverse selection should be evaluated. When adverse selection is expected to have material effects, the actuary should estimate the potential impact and recommend appropriate measures to mitigate these effects.

### 2. Risk classes used for testing

A different set of risk classes than those in the risk classification system should be used for testing purposes.

### 3. Effect of changes

Any changes in the risk classification system, industry practices, or business practices should be tested.

### 4. Quantitative analyses

The actuary should perform quantitative analyses of the impact of:

- Significant limitations due to compliance with applicable law
- Significant deviations from industry practices
- Significant limitations created by business practices
- Any changes in the risk classes or the assigned values
- Any material effects of adverse selection

## Summary

In most lines of business, setting rates on a case-by-case basis is impractical. Therefore, companies identify specific characteristics to use as rating variables, allowing them to segment

the insured population into more homogeneous, yet credible, groups for rating purposes. In selecting rating variables, companies should consider statistical validity, operational feasibility, social implications, and relevant laws and regulations.