This section explains the various criteria for evaluating the appropriateness of rating variables, as set forth by Robert Finger in "Risk Classification" (Finger 2001, pp. 292-301). The criteria can be grouped into the following categories:

- Statistical
- Operational
- Social
- Legal

## *Statistical Criteria*

The rating variables should reflect the variation in expected costs among different groups of insureds. Ideally, the company will have collected or can obtain data that enables it to test the statistical effectiveness of the rating variable being considered.[28] If so, the company should consider the following statistical criteria to help ensure the accuracy and reliability of the potential rating variable:

- Statistical significance
- Homogeneity
- Credibility

The rating variable should be a statistically significant risk differentiator. In other words, the expected cost estimates should vary for the different levels of the rating variable, the estimated differences should be within an acceptable level of statistical confidence, and the estimated differences should be relatively stable from one year to the next. If all the levels for a given rating variable have no statistical variation in loss experience, then the rating variable may not be useful. If instead the estimates of cost differences are different but the results are volatile, then it is less clear whether the rating variable is improving equity or not.

Second, the levels of a rating variable should represent distinct groups of risks with similar expected costs. In other words, the groups should be defined such that the risk potential is homogeneous within groups and heterogeneous between groups. If a group of insureds contains materially different risks, then the risks should be subdivided further by creating more levels of an existing rating variable or by introducing additional rating variables. When considering homogeneity, it is important to differentiate between expected and actual costs. Even truly identical risks may have different loss experience during a given policy period due to the random nature of the insurance events (i.e., even the highest-risk drivers will not necessarily have a claim every policy period and the lowest-risk driver may have a claim). The key for classification analysis is to identify and group risks for which the magnitude and variability of expected costs are similar; by doing so, the actuary will develop more accurate and equitable rates.

Finally, the number of risks in each group should either be large enough or stable enough or both for the actuary to be able to accurately estimate the costs. Actuaries refer to this as having sufficient credibility and this will be discussed in greater detail in Chapter 12. If a particular level of a rating variable includes too few risks or is not stable over time, then the experience may lack the credibility necessary to

[28] The factors can be tested using the techniques described later in this and the following chapters.

accurately estimate the costs. In such cases, the actuary should consider combining similar levels to increase the credibility or look for additional relevant data.

The science of classification requires balancing two objectives: grouping risks into a sufficient number of levels to ensure the risks within each group are homogeneous while being careful not to create too many granularly defined groups that may lead to instability in the estimated costs.

## *Operational Criteria*

Even if a rating variable effectively segments risk, it may not be practical to use in a rating algorithm due to operational considerations. For a rating variable to be considered practical, it should be

- Objective
- Inexpensive to administer
- Verifiable

First, the levels within a rating variable should have objective definitions. For example, it seems logical that the estimated costs for medical malpractice insurance vary by the skill level of a surgeon. However, the skill level of a surgeon is difficult to determine and somewhat subjective; therefore, it is not a practical choice for a rating variable. Instead, companies can use more objective rating variables like board certification, years of experience, and prior medical malpractice claims that serve as proxies for skill level.

Second, the operational cost to obtain the information necessary to properly classify and rate a given risk should not be too high. For example, there are building techniques and features that improve the ability of a home to withstand high winds. If these items significantly reduce expected losses, statistically speaking the company should implement a rating variable to recognize the differences. Unfortunately, the existence of some of the features cannot be easily identified without a very thorough inspection of the home performed by a trained professional. If the cost of the inspection significantly outweighs the potential benefit, then it may not make sense for a company to use that risk characteristic as a rating variable.

Third, the levels of a rating variable should not be easily manipulated by the insured or distribution channel, and should be easy for the insurer to verify. It is generally accepted that the number of miles driven is a risk differentiator for personal auto insurance. However, many car owners cannot accurately estimate how many miles their car will be driven in the upcoming policy period, and even if they can, the insurance companies may not currently have a cost-effective way to verify the accuracy of the amount estimated by the insured. Since some companies feel the insureds may not supply sufficiently accurate information, they have chosen not to use annual miles driven as a rating variable. Note, as technology evolves and on-board diagnostic devices become standard equipment in cars, the verifiability of this rating variable and how it is used in rating may be substantially different.

## *Social Criteria*

Insurance companies are selling insurance products to a variety of consumers; consequently, companies are affected by public perception. The following items affect the social acceptability of using a particular risk characteristic as a rating variable:

- Affordability
- Causality
- Controllability
- Privacy concerns

First, from a social perspective, it is desirable for insurance to be affordable for all risks. This is especially true when insurance is required by law (e.g., states require "proof of financial responsibility" from owners of vehicles and that is most easily achieved though personal automobile insurance) or required by a third party (e.g., lenders require homeowners insurance), or is merely desirable to facilitate ongoing operation (e.g., stores purchase commercial general liability insurance). In some cases, a particular risk characteristic may identify a small group of insureds whose risk level is extremely high, and if used as a rating variable, the resulting premium may be unaffordable for that high-risk class. To the extent that this occurs, companies may wish to or be required by regulators to combine classes and introduce subsidies. For example, 16-year-old drivers are generally higher risk than 17-year-old drivers. Some companies have chosen to use the same rates for 16- and 17-year-old drivers to minimize the affordability issues that arise when a family adds a 16-year-old to the auto policy. The company may be willing to accept the subsidy in recognition of the fact that the policy will be profitable in the long run as the teenager ages. Alternatively, companies have developed new insurance products that can support a lower rate for high-risk insureds by offering less coverage.

Second, in addition to being correlated with expected losses, some risk characteristics directly impact the amount of expected losses. From a social perspective, it is preferable if rating variables are based on characteristics that are causal in nature. For example, most people understand that the presence of a sump pump in a house has a direct effect on water damage losses to the house (both in propensity to have a claim and the severity of the claim). As such, a corresponding reduction in premium for the presence of a sump pump is likely to be socially acceptable. In recent years, personal lines insurers have introduced insurance credit scores, a measure of the insured's financial responsibility, into rating algorithms. Despite the strong statistical power in predicting losses, the use of this variable has resulted in a consumer backlash stemming from a belief that there is a lack of obvious causality to losses.

Third, it is preferable if an insured has some ability to control the class to which they belong and, consequently, be able to affect the premium charged.[29] For example, the type and quality of a company's loss control programs can have a significant effect on workers compensation expected losses. This is a controllable rating variable as insured companies can implement approved loss control programs in an

[29] This may seem to contradict the comment made in the operational criteria section that it is undesirable to have a rating variable that can be manipulated by the insured. The operational criterion refers to insureds or others supplying false information to earn a cheaper rate. The controllability criterion refers to the case where an insured can be motivated to improve his risk characteristic and consequently reduce his rate. The latter often has broader societal benefits (e.g., insureds purchasing cars with safety devices that afford insurance discounts).

effort to reduce expected losses and consequently reduce the charged premium. In contrast, insureds cannot control their age or gender. Interestingly, even though age and gender have been demonstrated to influence personal lines loss costs, some jurisdictions do not allow them as rating variables.

Finally, there can be significant privacy concerns associated with the use of particular rating variables. For example, technology exists that can track where a car is being driven and how safely the driver is driving. When the technology is standard in all vehicles, the information could be used to greatly improve the insurance companies' ability to accurately price a given risk. In order to address the privacy concern, the data is deemed to be protected and the insurance company is only able to use it with the express consent of the insured. Some companies have implemented usage-based insurance programs[30] on a voluntary basis. Of course, any such usage-based programs will be most effective if they can be used on all risks rather than just the ones who volunteer.[31]

## *Legal Criteria*

Most jurisdictions around the world have some level of law and regulation related to property and casualty insurance products. Currently in the United States, property and casualty insurance products are regulated by the states. Each state has laws and regulations concerning the pricing of insurance products, and the details vary greatly from state to state and from product to product. Most states have statutes that require insurance rates to be "not excessive, not inadequate, and not unfairly discriminatory." Additionally, some states' statutes may require certain rates to be "actuarially sound." How a state's executive branch interprets these statutes can vary significantly from state to state and even within a particular state over time.

Some states have promulgated regulations that include details about what is allowed and not allowed in risk classification rating for various property and casualty insurance products. It is imperative that the rate classification system be in compliance with the applicable laws and regulations of each jurisdiction in which a company is writing business.

For example, some states have statutes prohibiting the use of gender in rating insurance while others permit it as a rating variable. As a result, an insurer writing in multiple states may include gender as a rating variable in those states where it is permitted, but not include it in a state that prohibits its use for rating. Some states may allow the use of a rating variable, but may place restrictions on its use. For example, some states allow credit score to be used for rating personal insurance for new business, but do not allow insurers to raise the rates for renewal risks should the insured's credit worsen (although they may allow companies to reduce rates if the insured's credit score improves). Some states also prohibit certain variables from use in the rating algorithm but allow their use in underwriting. Underwriting variables may be used to guide risk selection decisions, but could also guide risk placement decisions.[32]

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[30]Usage-based insurance programs rely on on-board diagnostic devices to track various criteria about how the car is being driven (e.g., mileage by time of day and rapid changes in speed). The insurer adjusts the next policy term premium based on the usage information reported automatically in the prior term.

[31] The issue is one of self-selection. The only insureds who volunteer for the usage-based programs are those who benefit from it in the way of lower rates. Thus, the data cannot really be used to differentiate the high- and low-risk drivers.

[32] In some cases, placing a risk into a different company or tier may affect the rate (though the criteria are not considered "rating variables" by regulators).