3.3.4 Workers Compensation Size of Risk

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Many commercial lines products use relatively simple rating algorithms. Traditionally, workers' compensation rating algorithms did not include a variable for the size of the insured company. To address expected differences in expenses and loss levels for larger insureds, some workers' compensation insurers adjust the expense component for large risks, apply premium discounts, include loss constants, or use a combination of these methods.

Expense Component

As discussed in Section 2.5.2, expense provisions determined using the All Variable Expense Method will undercharge risks with premium below average and overcharge risks with premium above average. To adjust for this inequity, insurers may implement one of the following:

1. Calculate a variable expense provision that only applies to the first $\$X$ of standard premium. Consequently, policies with a standard premium exceeding $\$X$ will have a smaller percentage of expense relative to the total premium.

2. Charge an expense constant to all risks to cover expenses that do not vary by the policy size. Since the expense constant is a flat dollar amount, it represents a decreasing percentage of written premium as the policy size increases.

3. Apply a premium discount to policies with premium exceeding a specified amount.

We will illustrate the premium discount calculation using the data below, which is the same as the data used in the source text. You can find the calculations for the examples of this subsection in this worksheet.

Premium Range	Expense Percentage by Type			
	Production	General	Taxes	Profit
$0 - $5,000	15.0%	10.0%	3.0%	5.0%
$5,000 - $100,000	12.0%	8.0%	3.0%	5.0%
$100,000 - $500,000	9.0%	6.0%	3.0%	5.0%
$500,000 & above	6.0%	4.0%	3.0%	5.0%

The table above shows the expense percentages for four types of expenses for each premium range. The percentages for production and general expenses decrease as premium increases, recognizing that some of the expenses are fixed and do not vary by premium. Taxes and profit are the same for all premium ranges, so they are fully variable expenses.

The premium discount is determined by applying a graduated expense discount scale to different layers of the premium. To calculate the amount of premium discount, first calculate the discount percentage for each premium range. This is equal to the total expense percentage for the lowest premium range minus the total expense percentage for the premium range of interest, all divided by 1 minus the variable expenses, which are the percentage of taxes plus profit. The division is necessary because when the fixed expenses are reduced, the associated variable expenses are also reduced.

Premium Range	Expense Percentage by Type				[5] Total	[6] Expense Reduction	[7] Discount %
	[1] Production	[2] General	[3] Taxes	[4] Profit			
$0 - $5,000	15.0%	10.0%	3.0%	5.0%	33.0%	0.0%	0.0%
$5,000 - $100,000	12.0%	8.0%	3.0%	5.0%	28.0%	5.0%	5.4%
$100,000 - $500,000	9.0%	6.0%	3.0%	5.0%	23.0%	10.0%	10.9%
$500,000 & above	6.0%	4.0%	3.0%	5.0%	18.0%	15.0%	16.3%

Calculations:

- $[5] = [1] + [2] + [3] + [4]$
- $[6] = [5]_{\text{Row 1}} - [5]$
- $[7] = \dfrac{[6]}{1 - [3] - [4]}$

Next, multiply the discount percentage for a premium range by the premium in that range. Finally, sum the discounts across all premium ranges to get the total amount of premium discount. The table below summarizes the calculations for a policy with a standard premium of $400,000.

Premium Range	Expense Percentage by Type				[5] Total	[6] Expense Reduction	[7] Discount %	[8] Premium in Range	[9 Prem Disc
	[1] Production	[2] General	[3] Taxes	[4] Profit					
$0 - $5,000	15.0%	10.0%	3.0%	5.0%	33.0%	0.0%	0.0%	$5,000	$(
$5,000 - $100,000	12.0%	8.0%	3.0%	5.0%	28.0%	5.0%	5.4%	$95,000	$5,1
$100,000 - $500,000	9.0%	6.0%	3.0%	5.0%	23.0%	10.0%	10.9%	$300,000	$32,
$500,000 & above	6.0%	4.0%	3.0%	5.0%	18.0%	15.0%	16.3%	-	-
Total								**$400,000**	**$37,**

Example 3.3.4.1 [CAS Exam 5 2011 Q16]

Workers compensation insurers often offer a premium discount for large premium dollar accounts. Given the following expense information for workers compensation policies:

Premium Range	Expense Percentage by Type			
	Production	General	Taxes	Profit
$0 - $7,500	14%	10%	3%	5%
$7,500 - $75,000	10%	8%	3%	5%
$75,000 - $200,000	7%	6%	3%	5%
$200,000 & above	5%	4%	3%	5%

Calculate the total amount of premium discount for a policy with premium of $180,000.

Solution

Here is a breakdown of the steps:

1. Calculate the **total expense percentage** by premium range, starting at 32% and decreasing to 17%.
2. Compute the **expense reduction** for each premium range by subtracting the total expense percentage for that range from 32%.
3. To calculate the **discount percentage**, divide by $1-$ the expense percentages for taxes and profits. This means dividing by 0.92.
4. Compute the **premium in each range**, moving down the list until you reach a total premium of $180,000.
5. To obtain the **premium discount** for each premium range, multiply these premium amounts by the discount percentages for each premium range.
6. Finally, sum these values to obtain the total premium discount.

Premium Range	Expense Percentage by Type				[5] Total	[6] Expense Reduction	[7] Discount %	[8] Premium in Range	
	[1] Production	[2] General	[3] Taxes	[4] Profit					
$0 - $7,500	14%	10%	3%	5%	32%	0%	0%	$7,500	

Premium Range	Expense Percentage by Type				[5] Total	[6] Expense Reduction	[7] Discount %	[8] Premium in Range	F D
	[1] Production	[2] General	[3] Taxes	[4] Profit					
$7,500 - $75,000	10%	8%	3%	5%	26%	6%	6.52%	$67,500	$
$75,000 - $200,000	7%	6%	3%	5%	21%	11%	11.96%	$105,000	$
$200,000 & above	5%	4%	3%	5%	17%	15%	16.3%	-	
Total								**$180,000**	**$1**

Calculations:

- $[5] = [1] + [2] + [3] + [4]$
- $[6] = [5]_{\text{Row 1}} - [5]$
- $[7] = \dfrac{[6]}{1 - [3] - [4]}$
- $[9] = [7] \times [8]$

Therefore, the total amount of premium discount for a policy with a premium of $180,000 is **$16,956.52**.

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Loss Constants

Smaller workers compensation risks often exhibit worse loss experience compared to larger risks, and there are several theories to explain this:

1. Small companies may have less advanced safety programs due to the substantial capital required for implementation and maintenance.
2. They might lack programs designed to help injured employees return to work.
3. Experience rating, which results in lower rates for those with superior loss experience and higher rates for those with below-average experience, has a minimal impact on premiums for small insureds. Consequently, small insureds may be less motivated to prevent or manage injuries compared to large insureds.

Charging the same rate per exposure for all workers compensation policies would lead to undercharging the small risks and overcharging the large risks. Historically, to equalize the final expected loss ratios across all insured sizes, a loss constant is added to the premium for small insureds.

Let's look at an example to see how to determine the loss constant amount.

You are given the following premium and loss data on 1,500 policies.

Premium Range	Policies	Premium	Reported Loss
$0 - $2,500	1,000	$875,000	$700,000
$2,500+	500	$2,000,000	$1,400,000

Calculate the loss constant required to bring the loss experience of the smaller insureds in line with larger risks.

The loss ratio is calculated as the reported loss divided by the premium. For the small $(P \leq \$2{,}500)$ and large $(P > \$2{,}500)$ risks, the initial loss ratios are:

$$\text{Small risks:} \quad \text{Initial Loss Ratio} = \frac{\$700{,}000}{\$875{,}000} = 80\%$$

$$\text{Large risks:} \quad \text{Initial Loss Ratio} = \frac{\$1{,}400{,}000}{\$2{,}000{,}000} = 70\%$$

The initial loss ratio of the small risks is 80%, which is greater than the loss ratio of the large risks of 70%. To bring the loss experience of the smaller insureds in line with larger risks, we need to decrease the loss ratio of the small risks to 70%. This is done by increasing the premium to:

$$\frac{\$700{,}000}{0.7} = \$1{,}000{,}000$$

Since the required premium is $\$1{,}000{,}000$, but the current premium is $\$875{,}000$, there is a **premium shortfall** of $\$1{,}000{,}000 - \$875{,}000 = \$125{,}000$, which will be shared by 1,000 small insureds.

The **loss constant** applied to each small risk is calculated by dividing the premium shortfall by the number of small risk policies:

$$\frac{\$125{,}000}{1{,}000} = \mathbf{\$125}$$

Note that a loss constant is not needed when using multivariate approaches since the insurer can add a rating variable to account for the size of the risk.

To summarize, here are the steps to calculate the loss constant:

1. **Calculate the premium shortfall**: Divide the reported loss by the target loss ratio to determine the needed premium, then subtract the premium without the loss constant.
2. **Calculate the loss constant**: Divide the premium shortfall by the number of associated policies.