PINNACLE
ACTUARIAL RESOURCES, INC.
Consulting Actuaries
May 2003
Bloomington • Chicago • New York • San Francisco

Cost Allocation Mechanisms - Who Should Pay How Much?

By Joseph A. Herbers

You are the executive director or risk manager for an organization and now have the premium quotation or cost projections for the upcoming year. The question arises as to how to allocate those premiums and/or costs to various divisions within the organization or to each member of your group. What's fair? Who should pay how much?

These questions arise often in the everyday life of insurance purchasers and risk managers. Sometimes the cost allocation process is very arbitrary, or controlled either by an individual or by those who sit on the Board of Directors of the organization. We suggest a widely used and commonly accepted *objective* approach to such cost allocations for commercial casualty exposure.

The basic premise of any cost allocation system is that it should provide an equitable distribution of expected overall costs to individual entities. That is, it should be fair, but how does one define "fair?"

The Basic Model

Any technique used to allocate insurance costs among divisions within a company or self-insured group should reflect at least the following five items:

1. differences in exposure,
2. differences in costs by geographic location,
3. differences in loss experience among divisions,
4. emphasis on claim frequency more than claim severity, and,
5. statistical credibility of the data.

About the Author

Joseph A. Herbers
ACAS, MAAA

Mr. Herbers is a principal and consulting actuary of Pinnacle Actuarial Resources, Inc. in the Bloomington, Illinois, office. He has more than seventeen years of consulting experience, and holds a Bachelor's Degree in Mathematics from the University of Missouri. Mr. Herbers is an Associate of the Casualty Actuarial Society and a member of the American Academy of Actuaries. He is past Chair of the Program Planning Committee of the Casualty Actuarial Society and a current member of the Committee on Property and Liability Financial Reporting of the American Academy of Actuaries.

Mr. Herbers formerly worked as a consultant for Tillinghast and Miller, Herbers, Lehmann, & Associates, Inc. He has been responsible for funding and loss reserve studies for the commercial lines exposure of public entities, health care facilities, universities and other self-insured entities. He has considerable experience in the areas of loss reserving and ratemaking; costing of auto insurance reform measures, including choice no-fault initiatives; and private passenger auto classification analysis using multivariate methods.

He has given presentations and speeches on a variety of topics and has written articles on dynamic financial analysis, choice no-fault plans for automobile insurance, and Materiality and Statements of Actuarial Opinion.

Using these elements, the model will strike a balance between responsiveness (as differentiated by the first four factors) and stability (as dictated by the fifth factor).

Allocation models must consider the relative size, or exposure, among divisions. The commonly used exposure bases for various commercial casualty-type risks are shown below in Table 1.

Table 1

Line of Coverage	Typical Exposure Basis
General Liability	Gross Receipts, Payroll, # Faculty/Students, Area
Product Liability	Sales
Auto Liability	# Vehicles (Cars v. Trucks), Annual Mileage
Auto Physical Damage	Total # of Units (including trailers), $ Unit Values
Workers Compensation	Payroll
Property	Insured Values
Medical Malpractice	Hospital - # occupied beds, # Outpatient Visits Physicians/Surgeons - # Full-time Equivalents by Specialty and Surgical Involvement

Any cost allocation method that relies solely upon differences in exposure is missing other critical elements that should be considered. That is, there are significant differences in the underlying cost of providing insurance coverage based upon the geographic location of the risk. For example, medical malpractice costs are significantly greater in Cook County, Illinois, compared with downstate locales. Likewise, auto liability costs are significantly higher in urban areas, compared with rural locations. Furthermore, there are significant differences in workers compensation costs among states due to differences in benefit levels, types of industries, availability of medical care and other factors.

In order to incorporate such differences into a cost allocation model, we need access to benchmark loss costs between states and for territories within each state. Commonly used benchmarks include the advisory loss costs promulgated by the Insurance Services Office (ISO) for general liability, products liability, commercial automobile and medical malpractice exposures. Similar advisory loss costs are available from the National Council on Compensation Insurance (NCCI) for workers compensation exposure. Note however, that NCCI loss costs apply statewide and do not vary by territory within a given state. Benchmark loss costs can also be derived by analyzing rate filings for large insurance carriers with credible premium volume in each state.

The first two elements, namely differences in exposure and differences in insurance costs by geographic location, provide a good starting point for our cost-allocation mechanism. Using the product of these two elements (i.e., exposure x benchmark loss cost), we can develop a profile of the "expected losses" for each division, presuming each is an "average" risk. This is shown in Table 2.

We must always recognize, however, that these benchmark loss costs are a benchmark and nothing more. While it provides us with information useful for comparing the loss potential between divisions, it does not provide us with any information about the "true" differences in loss potential. Thus, we must incorporate the third element of the model, namely, the actual loss experience by division.

Factoring in the actual loss experience by division is where the details of the allocation process require additional thought. Should we use a five-year loss history? Should we use total limits losses, or cap individual claims at some limit? Should we use the losses for all lines of coverage? Should we exclude so-called "non-recurring" claims? The answers to these questions deserve thoughtful consideration because they are the "levers" that can make a considerable difference in the final cost allocations.

Table 2
Development of Expected Losses

Division	Exposure Period	Exposure	Benchmark Loss Cost	Expected Losses	Expected Losses at Retention
A	1/95 - 96	1,000	$32.40	$32,400	$25,920
	1/96 - 97	1,100	34.90	38,390	30,712
	1/97 - 98	1,200	35.20	42,240	33,792
	1/98 - 99	1,300	36.10	46,930	37,544
	1/99 - 00	1,400	37.00	51,800	41,440
B	1/95 - 96	940	18.14	17,052	13,641
	1/96 - 97	955	18.90	18,050	14,440
	1/97 - 98	960	19.00	18,240	14,592
	1/98 - 99	965	19.10	18,432	14,745
	1/99 - 00	970	19.20	18,624	14,899

When faced with such questions, we recommend the model use at least five but not more than ten years of data, to provide some balance between stability and

responsiveness. That is, we don't expect losses that occurred more than ten years ago will have much predictive value for the upcoming year's losses. At the same time, we do not recommend using less than five years of data because poor experience in one or two of the latest five years may not be a good indicator of expectations in the upcoming year.

We also recommend that individual claims be capped at some limit commensurate with the expected "working layer" of claims for the type of risk considered. For example, if the bulk of all claims in the past five to ten years have been less than $75,000, then a $75,000 limit should be considered in the model. The primary objective of this allocation mechanism is to provide an equitable distribution of costs according to your best estimate of future loss potential.

Loss control, risk management and safety programs generally have more of an impact on mitigating the occurrence of a claim than the dollar amount of the claim once it has occurred. Hence, the frequency of claims is deemed to be more controllable than claim severity at the shop room floor level. Hence, the expectation of future losses should focus more on the claim frequency element than the severity. This is another argument for limiting the amount of individual claims in the cost-allocation model.

Once we have decided on the number of years experience and the retention limit(s) to use in the model, we can construct an experience modification factor for each division, representing a measure of how much lower or higher that division's loss experience is, relative to the insurance industry benchmark expected losses. First, however, we must make two adjustments to the expected losses already calculated. First, we must adjust them to the same retention limit as that used for limiting actual claims. For the sake of illustration, the expected losses in Table 2 were adjusted by a factor of .90 to adjust the benchmark expected losses to the $100,000 retention limits. Second, we must adjust the expected losses to the level of reported losses expected, given the evaluation date of the losses. That is, the expected losses calculated in Table 2 reflect a full annual accrual for losses. Since such losses will take time - sometimes years - to develop fully, we apply a factor (i.e., percent of ultimate) to the expected losses to adjust them down to the level of reported incurred losses, based on the number of months between the exposure period and the loss evaluation date as shown in Table 3.

Table 3
Development of Experience Modification Factor

Division	Exposure Period	Expected Losses at Retention Limits	Expected % of Ult. Losses Reported	Reported Losses at Retention Limits Expected	Reported Losses at Retention Limits Actual	Experience Modification Factor
A	1/95 - 96	$25,920	85.2%	$22,084	5,000	0.226
	1/96 - 97	30,712	72.9%	22,389	13,890	0.620
	1/97 - 98	33,792	67.0%	22,641	14,000	0.618
	1/98 - 99	37,544	62.5%	23,465	360	0.015
	1/99 - 00	41,440	58.2%	24,118	29,877	1.239
	Subtotal	169,408		114,697	63,127	0.550
B	1/95 - 96	13,641	85.2%	11,622	25,430	2.188
	1/96 - 97	14,440	72.9%	10,527	8,000	0.760
	1/97 - 98	14,592	67.0%	9,777	12,050	1.233
	1/98 - 99	14,745	62.5%	9,216	8,623	0.936
	1/99 - 00	14,899	58.2%	8,671	7,900	0.911
	Subtotal	72,317		49,812	62,003	1.245

So far, the model has incorporated four of the five necessary elements for a well-structured cost-allocation mechanism. The fifth element, credibility, is a measure of the predictive value of the data. Simply put, it is a statistical measure between 0.0 and 1.0 that indicates how much you should "believe" what the data is telling you, as compared with what you might otherwise expect. Credibility measures vary, but many use the underlying number of claims as the determinant of the statistical value of the data. Clearly, a larger body of claims will provide a better prediction of future claims than a small body and vice versa. Hence, the larger body of claims will generate a higher credibility value.

For example, assume the full credibility measure is 1,000 claims and Division A's five-year loss history involves 125 claims reported to date. Using the square root rule, the credibility assigned to that body of data would be .353 (square root of 125/1000). This implies that the predictive value of the claims history is only about 35%. We will use this credibility value in deriving a credibility-weighted experience modification factor. Let's assume the five-year loss experience for all divisions combined is fully credible for predicting the upcoming year's losses and that the average total experience modification factor is .855. This implies that for the group as a whole, the actual losses were 14.5% lower than those indicated by the insurance industry benchmark expected losses. We then incorporate the credibility measures for individual divisions directly as follows in Table 4.

Table 4
Development of Credibility-Weighted Experience Modification Factors

Division	5 Year Exp. Mod. Factor	Credibility	Credibility Weighted Exp. Mod. Factor
A	0.550	0.353	0.747
B	1.245	0.405	1.013
C	0.950	0.821	0.933
D	1.012	0.477	0.930
Total	0.855	1.000	

If we define the five-year experience modification factor by division as M and the credibility factor as Z, then the credibility-weighted experience modification factors were computed as:

$$[M \times Z] + [\text{Total } M \times (1 - Z)]$$

Now that all five of the essential elements are in the model, the cost allocation mechanism follows directly by computing expected losses for the upcoming exposure year, adjusted by the credibility-weighted experience modification factor just computed as in Table 5.

Table 5
Development of Modified Expected Losses

Division	Upcoming Year Exp. losses	Credibility Weighted Exp. Mod. Factor	Modified Expected Losses	% of Total
A	$45,000	0.747	$33,636	18.57%
B	15,000	1.013	15,193	8.39%
C	92,000	0.933	85,836	47.38%
D	50,000	0.930	46,494	25.66%
Total	202,000		181,159	100.0%

The percentages in the far right-hand column of Table 5 provide us with the most equitable allocation of costs between divisions. These percentages reflect differences between the divisions regarding exposure, the expected cost of insurance, and the loss experience itself. It incorporates a measure of statistical credibility that factors in the relative predictive value of the actual loss experience, and it provides a reasonable balance between stability and responsiveness.

This model has been used successfully for many years in cost allocation applications for a variety of entities. The model itself is generally accepted because it is fairly easy to understand, and it provides an objective measure of the true differences in loss potential among divisions within an entity. The two aspects of the model that generate the most discussion relate to the number of years of data to be used and claim severity retention level.

For example, if at the end of the exercise the risk manager wanted to test the sensitivity of the indicated cost allocations using a $100,000 retention level rather than $75,000, the expected losses would need to be adjusted to the higher retention level and the actual reported incurred losses would need to be adjusted as well. All remaining elements of the model would flow through, providing an alternate view of equitable cost allocations.

The "correct" retention level may be difficult to determine. However, one would generally want to use a retention level commensurate with the risk's working layer. That is, the retention level would generally be set at some level at which there are very few claims above that amount in the historical data.

Likewise, sensitivity testing can be viewed by varying the number of years in the historical data. This may be of vital interest to a particular division that may have had a large claim several years ago, and seeks to benefit from an allocation formula that relies on fewer years of data. Ultimately, the number of years of data used in the allocation model should be considered from the viewpoint of credibility.

For more information about Cost Allocation Mechanisms for your business, contact Joe Herbers at Pinnacle Actuarial Resources, Inc. (309) 665-5010 or by email at jherbers@pinnacleactuaries.com.