The Pricing of Group Life Insurance Schemes

By - Marc Bastien

1. Introduction

This paper has been written to provide the reader with a solid grasp of group life insurance pricing issues and factors. Naturally, in relatively short space, an in-depth discussion of the issues and factors is not possible. For example, some consideration is given to scheme design because of its effect on pricing, although a more thorough analysis of the advantage and disadvantages of certain plan designs are outside the scope of this paper.

The Indian group life market continues to develop and expand with the arrival of private sector life insurers. This phenomenon can partially be explained by the fact that many of the new life insurers have majority owners that are involved in another business, such as in industry or financial services. These other holdings then represent a natural opportunity to provide insurance protection to the employees of the group.

However, the main attraction of group insurance is the ability to cover large number of individuals in a cost efficient manner. Group insurance is cost efficient because it pays proportionally lower commissions and incurs lower acquisition expenses; by its nature pre-empts the need for individual underwriting; makes use of a single contract with the plan sponsor instead of having to issue individual policies; and efficiently collects premium payments through payroll deductions or a single payment from the employer. The insurance cover also has relatively simple data requirements: there are for example no cash values per employee and there is no need for seriatim valuation. Thus, in comparison to individual life insurance, group life insurance is more cost-effective per thousand of rupees insurance cover.

2. General Characteristics of Group Life Insurance

Group life insurance, within certain restrictions and conditions, provides insurance to members of a group without requiring evidence of insurability. There is a single policy, called the master contract, between the insurer and the plan sponsor. Individual group members may also be provided with “certificates of insurance” that outline the detail of the insurance cover.

Various types of groups can be covered under the group insurance mechanism. The most common group consists of employees of a single employer. Other possibilities are employees of multiple employers, members of a professional association, or members of labor unions. In all such groups, the employee chooses his or her beneficiaries. Debtor-creditor groups form a distinct type of group where there is typically some required evidence of insurability and where the creditor is the beneficiary of the insurance. Other groups, such as multi-level sales associations, students or parents of students, members of clubs or other organizations, purchasers of certain items such as cars, can take advantage of group insurance administrative efficiency, but normally require some evidence of insurability for members to be covered, since in effect, such groups can be open to anti-selection and it is difficult to ascertain the mortality risk. This paper will focus on group insurance for employees of a single employer, although many of the concepts and issues discussed herein are valid for the other groups as well.
Group insurance typically consists of one-year renewable term life insurance that pays a fixed benefit upon the death of the employee. There are usually no exclusions for the basic life cover other than for suicide in the first year of cover. At the end of the coverage year, the insurance automatically renews without employees having to provide evidence.

The availability of various supplementary riders to the basic life cover makes the group scheme even more attractive and valuable to employees. Insurers in India are often offering a few or all of the following riders: accidental death cover (ADB); critical illness (CI) cover; accident-only or accident-and-sickness Total and Permanent Disability (TPD) cover which can provide benefits either as a lump-sum or over several years; and some partial disability benefits (containing schedules of benefits per event, such as for the loss of one hand). The conditions and exclusions vary by type of rider. The CI and disability riders may be either of an additional payment kind or may accelerate (or prepay) the base life insurance cover. The definition used in TPD is typically very strict, such as the inability to earn any income for the remainder of a lifetime. For a modest increase in the group premium, a terminal illness benefit feature is also sometimes included that prepays the sum assured when it has been ascertained that the life insured has fewer than six months to live. Finally, insurers are offering health riders (e.g. daily hospital allowance) and savings or pensions products. Whatever riders are chosen, the actuary should heed regulations in India that place limits on the portion of the premium use to pay for riders.

An employee’s spouse and children can also be covered under the group life insurance scheme. This is often called dependent insurance and coverage levels are lower than for the employee.

Unfortunately, the experience on dependents should be worse than for employees. As dependent insurance is almost always voluntary, there is a greater level of anti-selection. Also, spouses are not required to work, and therefore should on average not be as healthy as the employee. As such, spouses should be asked to sign a health declaration or fill a short-form questionnaire. Children may be automatically covered from, for example, 1 month of age until age 19 with relatively small sums insured. The rates for dependent insurance should at least be age-banded and should generally be more conservative than those for employees. When the actuary prices the group scheme, dependent benefits should be considered separately.

This paper will discuss in fair detail employer-employee yearly-renewable group life insurance and will not analyze the implications and challenges of offering the various riders or dependent benefits. Naturally, many of the considerations discussed in this paper for one-year term insurance also apply to the various riders.

Thus, one of the main defining characteristics of employer-employee group insurance is that there is no need, up to a certain level of cover, for individual evidence of insurability. There are multiple reasons for this feature. First, employees are generally healthier than the general population since they must be fit enough to work full-time. Also, some employers require health screenings before offering permanent employment and would less likely employ ill or disabled lives. Furthermore, there is less anti-selection since employees normally cannot choose the amount of basic insurance (the basic coverage amount is pre-determined per employee) and also because individuals would not normally apply for employment at a specific company for the express purpose of obtaining insurance, especially as there are barriers to becoming employed. Finally, most importantly, the fact that all employees (in a compulsory plan) or a certain minimum percentage of employees (in a voluntary plan) are covered by insurance means that there is a good spread of the mortality risk. It is well known that roughly 95% of individual insurance applicants are accepted without substandard ratings, and that in effect the entire cost of individual underwriting is to catch that 5% of applicants who are then declined or rated. In the context of group insurance, that 5% of individual applicants would either be unfit to work (and therefore not eligible to be covered) or, for those who are working, the extra mortality risk they represent can then be spread over the remaining lives of the group.

The task of the group actuary is then to appropriately estimate the overall risk of the group to be insured, and not to inquire about the health status of individual members. In estimating this overall mortality risk, it is important to design a scheme to avoid anti-selection by individuals within a group. Certain principles must be adhered to:

- Insurance must be incidental to the existence of the group. This is clearly the case for employer-employee relationships.

- The determination of benefits per member should not be at the discretion of the employer or employee. That is, there should be an automatic basis to determine the level of coverage per employee. The level of cover may the same for all employees or may be a function of employee rank (e.g. worker, manager, executive), salary, years of employment, or a combination of these. The objective is to avoid anti-selection by less healthy employees who would choose higher levels of coverage. Various scheme designs can be discussed with employers to determine the more suitable option. If benefits were linked to a variable, for example salary or years of employment, an annual re-determination of the insurance cover would have to be carried out.

- Only permanent full time employees should be eligible for insurance cover. The employee should be actively at work on the date he or she becomes eligible for insurance. Furthermore, extra eligibility conditions may apply such as not having been absent from work due to sickness for more than 3 weeks per year during the previous 2 years (that is, the employee should have been working the normal hours required by the employer). Certain age restrictions may also apply, requiring that the employee be younger than age 60 and have joined the employer before attaining age 55.

- New employees must normally satisfy a waiting period, usually a month, before becoming eligible for insurance. In a voluntary plan, once they have satisfied this probationary period, they must join the scheme within 30 days or otherwise have to provide some evidence of insurability.

- Generally, coverage ceases after a grace period if the scheme sponsor fails to pay the due premium; the employee reaches a certain age or retires; or employment is terminated. There may be instances when the employer continues to pay the employee even if he or she is temporarily off the job. It is important for the insurer to clarify instances where this is allowed and for what duration. Also, the employer should not employ its own discretion as to whether to continue paying an employee who is not actively at work, but should follow an established policy that is applied to all employees or certain classes of employees. In the end, there should be no ambiguity about whether the insurance coverage is in force when the employee is not actively at work, for example as a result of illness or maternal leave. In the US, for example, various approaches are used to handle worker disability. The least generous approach is to not offer disability provisions of any kind, but to generally continue coverage if the employee continues to receive a regular salary, but normally not beyond 6 months (since that is when an employee is considered to be permanently disabled). Somewhat more generous is *extended death benefit coverage*, which provides one year of continued life coverage if the insured's insurance terminates prior to age 60 and the insured is totally disabled until death. Another approach is to continue to provide life coverage until age 60 (or 65), and to waive the group life premium, for employees who have been totally disabled for more than 6 months and remain disabled until death. Usually, annual proof of disability is required for continued waiver of premium. The most generous approach is to pre-pay a percentage of the life benefit over a period, typically 5 years, as long as the insured is totally and permanently disabled. Each of these various approaches has a serious impact on the levels of mortality rates to use when pricing a scheme.

- If the scheme or employment terminates, it is possible to extend coverage by 30 days to provide employees some time to find new insurance cover. Conversion options to individual insurance are discussed separately.

The "Free Cover Limit" (FCL) is the maximum amount of insurance cover that does not require any evidence of insurability from participating employees. The FCL is also, perhaps more fittingly, called the "No Evidence Limit" or "Automatic Acceptance Limit." Having a FCL is a significant cost and time saving feature.

The FCL in some developed markets can be very high. The problem with a very high FCL is that it invites anti-selection and thus careful consideration must be given in setting these limits. In theory, the FCL could be set at the point where the cost of asking for evidence of insurability is less than the overall increase in mortality rates. This is difficult to determine in practice since the higher the FCL, the more there is potential for anti-selection.

The most significant parameters in selecting the FCL are the number of employees that will be covered under the life scheme and the average level of benefits among the employees. Therefore, the insurer should try to vary the FCL by size of group and the average benefit level amongst members of a group, as demonstrated in Table 1. Small groups will have a lower FCL because the decision to obtain group insurance coverage, and perhaps even the levels of coverage, may be influenced by top employees who are possibly in poorer health. That is, the smaller the group, the more there is anti-selection.

Table 1: Example of Free Cover Limits

Participating Employees	FCL	Maximum FCL (INR)
Up to 20	Nil	Nil
21 to 50	2.5 x Average Sum Insured	1,000,000
51 to 100	3 x Average Sum Insured	2,000,000
101 to 200	4 x Average Sum Insured	2,500,000
201 to 500	5 x Average Sum Insured	3,000,000
501 to 1,000	6 x Average Sum Insured	4,000,000
1,001 – 2,000	7 x Average Sum Insured	4,500,000
Over 2,000	8 x Average Sum Insured	5,000,000

Suppose a group consists of 100 employees: 80 are workers, 15 are managers, and 5 are executives. If the workers were to obtain 2 lakh coverage, the managers 5 lakh coverage, and the executives 10 lakh coverage, then the average sum assured is INR 2,85,000 and the FCL of 8.55 lakh (i.e. 3 times 2.85 as per the table above) is violated by the executives' benefit. The maximum available cover for executives then would be INR 8,29,411. Otherwise, some evidence of insurability would have to be provided.

Naturally, benefit levels must bear a reasonable relationship to salary levels. For example, if all members of a group of 110 lives are insured for a maximum 30 lakh, as per the table above, but earn 3 lakh per year, this should be cause for some concern. Multiples of annual earned income from 1 to 3 are recommendable, and normally should not exceed 5 times annual earned income. This is further complicated if accidental death coverage is included.

In addition to a maximum FCL, the insurer may also request that there be minimum sums insured. For example, the FCL for a group of 200 lives might be 8 lakh, and the minimum sum assured 1 lakh.

If the scheme is not compulsory, minimum participation levels should be established in order to allow and to set the Free Cover Limit. This is necessary to avoid excessive anti-selection by the less healthy members of a group of employees. The participation limits should be set according to the number of *eligible* employees, and once the participation rate is known, the FCL is then computed according to the *actual* number of employees joining the scheme (i.e. the *participating* employees). Suppose for example that a company has 250 eligible employees but only 65% opt for insurance. Then according to Table 2, no FCL would be permitted. If slightly over 75% of employees opted for the insurance, that is 188 lives, then the FCL would be, as per Table 1, 4 times the average sum assured, up to 25 lakh.

Table 2: Minimum Participation Limits

Number of employees	Minimum Participation Limit
Up to 20	N/A
21 to 50	90%
51 to 100	85%
101 to 200	80%
201 to 500	75%
501 to 1,000	70%
1,001 – 2,000	65%
Over 2,000	60%

If the number of participating employees is less than the required minimum, then the insurer, based on the actual level of participation, can decline to offer a FCL, quote a reduced FCL, increase the premium rate, or ask for evidence of insurability from the members.

To avoid any problems of anti-selection, the insurer should also ensure that there is no existing group life insurance in place; otherwise, two or more insurers may together be unwittingly providing excessive FCL levels.

Employees who wish to avail themselves of cover above the FCL will have to provide evidence of insurability. The usual practice is to underwrite for the amount exceeding the FCL, not the entire coverage amount including the FCL. As such, the insurer should develop age and amount underwriting evidence requirements. For modest amounts above the FCL at younger ages, only a health declaration or short questionnaire may be required; for larger amounts and for older ages, the underwriting requirements would progressively become comprehensive and eventually would include full medical and financial underwriting. If a member is found to be substandard, the rating only applies to the amount exceeding the FCL.

Naturally, compulsory plans, that is, plans where the employer pays the full premium, are much easier to administer. Voluntary plans, whereby employees are expected to pay for a portion of the insurance premium, are more difficult to administer and complicate the enrollment process since individual employees must assent to being covered and minimum participating limits must be met. The advantage of participating plans however is that they help defray the cost of insurance, and thus may provide coverage better suited to employees' needs, such as higher sums assured. Employee contributions are normally automatically deducted from payroll.

3. Estimating Claim Costs

One of the more important tasks of the group actuary is to estimate the mortality that a particular group is expected to experience. The greater the uncertainty of the estimate, the greater will have to be the security margin. In this paper, the expected cost of mortality, including any security margins in the assumed mortality rates, will be referred to as the *expected claims cost*.

In a market where there are no available group mortality statistics, estimating the claims cost can be a somewhat arduous task. The actuary faces two fiends, namely the risk of misestimation, which is the failure to appropriately set the mortality rate by considering and appropriately reflecting various parameters affecting the group's mortality risk, and, secondly, the trend risk, which is the failure to make adjustments in rates to account for developing patterns in the group's expected mortality. However, since group insurance is normally one-year renewable and without rate guarantees, the actuary can always revise pricing for each year of developing experience.

An actuary in India will have to make an informed guess as to a particular group's expected mortality. It is therefore the task of this actuary to minimize misestimation risk by identifying and reflecting various rating factors as well as accounting for mortality trends. Normally, he or she will have a basic idea as to the mortality for a specific kind of group and will then adjust this mortality for various rating factors, such as occupation, industry or geographical location, for other groups.

3.1 The Relationship of Group Mortality to Other Types of Mortality

It is perhaps tenuous to identify relationships between individual insured mortality, group insured mortality, and population mortality. In theory, group mortality (expressed in aggregated rates) should be worse than individual insurance mortality during early policy durations (i.e. during the select period) but slightly better than individual insured mortality at ultimate durations. The theory for this is that the effect of underwriting on individual insureds eventually wears off during the selection period, whilst group insured mortality represents the aggregate mortality of continually replenished workers as older or less fit lives terminate their coverage by leaving their employment.

Group mortality in aggregate should be better than population mortality since the population contains lives too disabled or ill to work. However, some groups by their occupation or industry may indeed expect to experience higher than population mortality.

When examining the experience of the US, these relationships hold true. The group experience is from the Society of Actuaries 1975-1979 study of group assured mortality (with over 13 million male life years exposed and over 7 million female life years exposed). The population mortality rates are from US census figures. Finally, the individual insurance rates are obtained from the Society of Actuaries medically underwritten experience study. Some rates have been adjusted to be on an age-last birthday basis, and the average of 5 ages has been used to determine the central age rate.

Looking at the male rates in Table 3, we observe that the group experience is 50-70% of the population mortality, with an increasing percentage by attained age, except for the youngest age category where presumably accidental deaths have a significant impact. The group rates however are higher than individual mortality rates during the early selection period, but they are quite close by the 10th policy anniversary and eventually are lower than individual rates at the ultimate duration (the US table is 15-year select and then ultimate).

Table 3: US Male Group, Population, and Individual Select and Ultimate Mortality

Central Age (x)	SoA Group 1975-79 Study	US 1979-81 Population	US 1975-80 Basic (Ordinary Insured) 15-year select table				
			$q_{[x]}$	$q_{[x-5]+5}$	$q_{[x-10]+10}$	Ultimate $q_x = q_{[x-16]+16}$	
	Male Mortality Rates (Per Mille)						
22	1.460	1.990	0.928	1.250	1.454	1.656	
27	1.010	1.932	0.806	0.930	1.176	1.458	
32	1.040	1.981	0.762	1.004	1.088	1.372	
37	1.410	2.547	0.874	1.450	1.476	1.664	
42	2.200	3.835	1.222	2.252	2.430	2.554	
47	3.680	6.133	1.796	3.452	3.942	4.398	
52	6.190	9.751	2.518	4.942	5.748	7.296	
57	9.870	14.996	3.546	6.890	8.792	11.886	
62	15.620	23.101	4.906	10.878	13.884	19.542	
	Male Group Mortality Rates As % of Other Rates						Individual Ultimate to Population
22	100%	73%	157%	117%	100%	88%	83%
27	100%	52%	125%	109%	86%	69%	75%
32	100%	52%	136%	104%	96%	76%	69%
37	100%	55%	161%	97%	96%	85%	65%
42	100%	57%	180%	98%	91%	86%	67%
47	100%	60%	205%	107%	93%	84%	72%
52	100%	63%	246%	125%	108%	85%	75%
57	100%	66%	278%	143%	112%	83%	79%
62	100%	68%	318%	144%	113%	80%	85%

The same relationships can be discerned in Table 4 containing US female experience, except that female group experience is even lighter when compared to the population or individual experience. For example, female group experience is lower at all but one age-band than the individual mortality at the 5th select year. It is also interesting to note how the individual female ultimate rates are close to population mortality, unlike the fairly large discounts observed for in the male experience.

Table 4: US Female Group, Population, and Individual Select and Ultimate Mortality

Central Age (x)	SoA Group 1975-79 Study	US 1979-81 Population	US 1975-80 Basic (Ordinary Insured) 15-year select table				
			$q_{[x]}$	$q_{[x-5]+5}$	$q_{[x-10]+10}$	Ultimate $q_x = q_{[x-16]+16}$	
	Female Mortality Rates (Per Mille)						
22	0.410	0.621	0.392	0.494	0.626	0.634	
27	0.430	0.690	0.386	0.524	0.624	0.650	
32	0.610	0.873	0.480	0.708	0.736	0.806	
37	0.770	1.317	0.634	1.082	1.184	1.272	
42	1.050	2.097	0.908	1.674	1.990	2.158	
47	1.880	3.336	1.204	2.402	3.048	3.294	
52	2.820	5.147	1.520	3.142	4.326	4.918	
57	4.050	7.722	1.990	4.216	6.064	7.544	
62	6.520	11.804	2.756	5.864	8.258	11.370	
	Female Group Mortality Rates As % of Other Rates						Individual Ultimate to Population
22	100%	66%	105%	83%	65%	65%	102%
27	100%	62%	111%	82%	69%	66%	94%
32	100%	70%	127%	86%	83%	76%	92%
37	100%	58%	121%	71%	65%	61%	97%
42	100%	50%	116%	63%	53%	49%	103%
47	100%	56%	156%	78%	62%	57%	99%
52	100%	55%	186%	90%	65%	57%	96%
57	100%	52%	204%	96%	67%	54%	98%
62	100%	55%	237%	111%	79%	57%	96%

In light of the above, it would be a reasonable premise to state that group insurance mortality should be lighter than general population mortality, especially given that group insurance is more likely to consist of urban employees forming the middle and upper socio-economic echelons. It also would be reasonable to assume that the best (white-collar, professional, and managerial groups) would experience (within a reasonable percentage) the expected experience of individually insured lives some years after the initial selection. Since the LIC 1994-1996 individual mortality table already does exclude the positive selection effect of the first two policy years, using it is a reasonable starting point for the best groups. In practice, companies are using even lighter rates than the LIC table for the best groups.

3.2 Insured and Population Mortality in India

Of course, there is some specific data concerning India. We can for example have a rough idea of the relationship of the LIC 1994-1996 table to the general population mortality, as contained in Table 5. The LIC study by P.C. Gupta provided crude LIC experience for rural and urban areas. The LIC experience however combined males and female lives so that comparison with census rates might be somewhat distorted. The census rates are from the Sample Registration System, Fertility and Mortality Indicators, 1992. Note that the difference in exposure period between the two studies has not been accounted for, and therefore the ratios of the LIC to population mortality should be somewhat higher due to population mortality improvements until 1995.

Table 5: LIC 1994-1996 Crude Mortality Rates to 1992 SRS Population Mortality Estimates

Ages	LIC Rural	LIC Urban	LIC Total	Census Rural	Census Urban	Census Total
20-24	1.20	0.78	1.01	3.10	2.00	2.60
25-29	1.07	0.93	1.01	2.90	2.10	2.54
30-34	1.26	0.97	1.13	3.50	2.30	2.94
35-39	1.58	1.33	1.46	4.00	3.00	3.52
40-44	2.38	2.00	2.20	5.40	4.00	4.73
45-49	3.72	3.24	3.50	7.80	6.40	7.14
50-54	6.22	5.07	5.69	11.80	10.20	11.06
55-59	9.71	8.12	8.94	18.20	16.40	17.32
60-64	16.52	12.98	14.65	29.40	25.50	27.33
65-69	25.16	18.55	21.36	45.40	37.10	40.63
Total	3.06	2.61	2.84	6.65	5.50	6.11

For the rates contained in Table 5, separate exposures were available for LIC rural and urban experience, and the totals LIC rates are based on these separate exposures. The census urban total and census rural total use the corresponding LIC exposures. The LIC data contained medically underwritten business only (at duration 2 and above), based on a sample of 22 rural divisions and 10 urban divisions, having exposures and deaths of 3,561,221 lives and 10,899 deaths for the rural areas and 3,169,778 lives and 8,280 deaths for the urban areas. Overall the LIC mortality is roughly half of the population mortality (identically aged-weighted based on LIC exposures).

Table 6: Ratios of LIC Rural and Urban Mortality Rated to Corresponding Population Rates

Ages	LIC Rural to Census Rural	LIC Urban to Census Urban	LIC total to Census Total
20-24	39%	39%	39%
25-29	37%	44%	40%
30-34	36%	42%	38%
35-39	40%	44%	42%
40-44	44%	50%	46%
45-49	48%	51%	49%
50-54	53%	50%	51%
55-59	53%	50%	52%
60-64	56%	51%	54%
65-69	55%	50%	53%
Total	46%	47%	47%

3.3 **Mortality Improvements in India**

Of course, it would be imprudent to simply use the LIC 1994-1996 tables as is. Other factors must be taken into account, such as mortality improvements. Figure 1 shows the implied mortality improvements that have occurred between the two LIC study periods. Note that the rates for ages 85 in the LIC 1994-1996 table were set to be the same as for the previous table, due to lack of exposure.

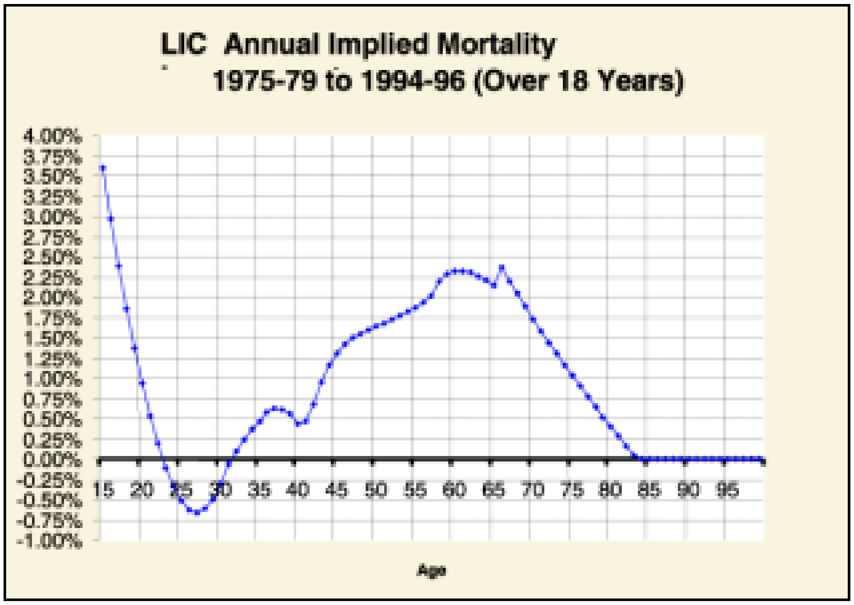

Figure 1: LIC Implied Annual Mortality Improvements by Age

It is reasonable that improvements have continued to occur since the last study was carried out, and one could compute the discounts using various mortality improvement assumptions, as shown in Figure 2.

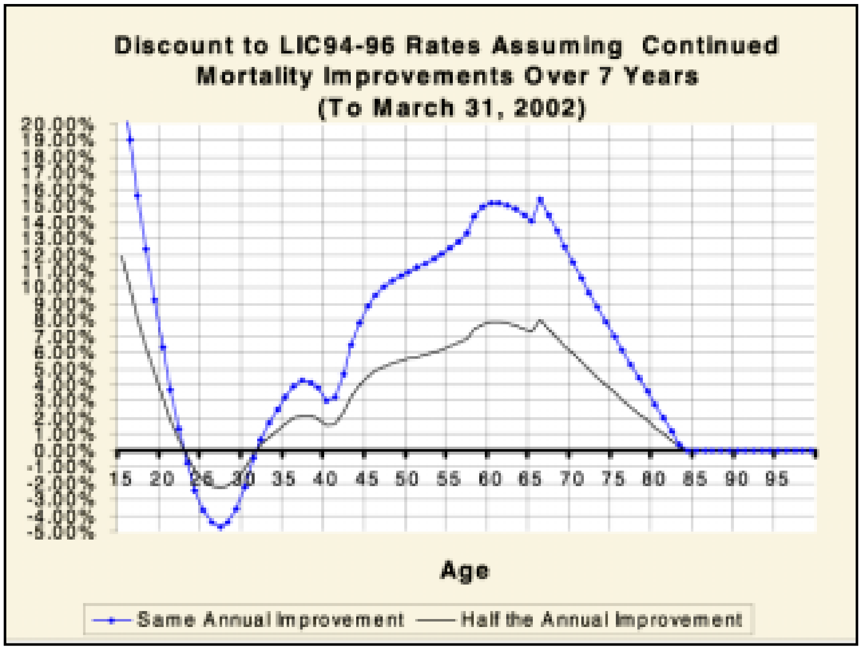

Figure 2: Various Mortality Discounts by Issue Age

The prudent actuary should also compute mortality improvements in the general population, to ensure that the improvements observed from the individually insured population are not greater than that observed for the general population. If this were the case, lower assumed mortality improvements could be reflected.

3.4 Age and Gender

When trying to arrive at a quote for a potential client, the actuary will naturally want to reflect age and gender. The female gender can simply be reflected by using, for example, a 3-year age setback on the male rates. Alternatively, the actuary can compute discounts based on the assumed proportion of females in a group.

Age naturally will have a heavy bearing on the average rate. Using the average of ages to determine the overall rate is inappropriate, since mortality increases exponentially. Therefore in order to produce an appropriate quote, the actuary will have to have a fairly precise distribution of ages. Sometimes only the year of birth is provided. In that case, one can subtract the year of birth from the current year and possibly make further adjustment as to when the plan becomes effective, especially if the base table is on an age-nearest basis.

3.5 Occupation Classes and Industry

Other than gender and age, a common rating factor used in group insurance is occupation and industry.

Social status is clearly an important determinant of expected mortality levels. Social status itself can be defined in terms of occupation or in terms of income.

The effect of socio-economic status can be discerned in the decennial studies carried out by the British national statistical office. Figure 3 shows the age-standardized all-cause mortality rates by social class, males aged 20-64, in the United Kingdom from 1991-1993. Approximately 25% of the British population belongs to the professional and managerial classes, 50% to the skilled manual and skilled non-manual classes, and the remaining 25% in the partly skilled and the unskilled categories. The mortality for the first three classes is fairly even with perhaps a 10% difference between the professional and the skilled non-manual classes; the skilled manual and the partly skilled classes have an extra 65% mortality compared to the first three classes; and finally the last class experiences about 185% extra mortality to the first three classes, a substantial difference.

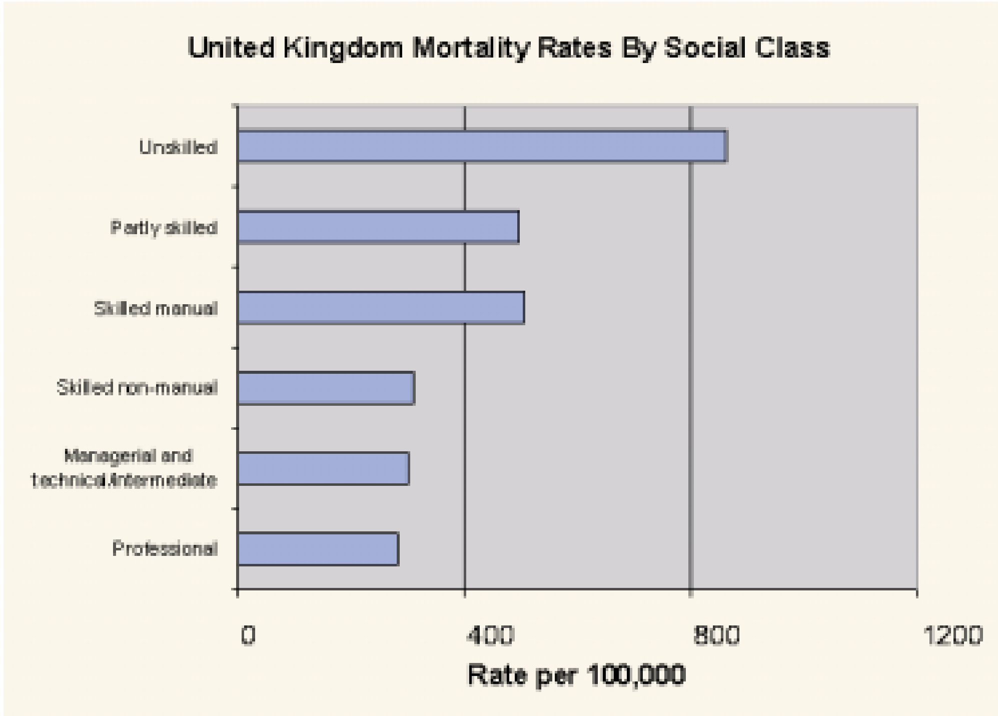

Figure 3: United Kingdom Mortality Rates by Social Class

The main conclusion of the British study is that there is a clear socio-economic correlation to all-cause mortality. Interestingly, the study found little evidence for geographic variation in the mortality of the professional class (i.e., the very best class). However, it found that the geographic differences in mortality for the unskilled class were considerably greater than in all other classes. Furthermore, even though both social class and location of residence contributed to variations in mortality, the contribution made by social class was greater. The broad implication for group life insurance then is that social class is a more important rating factor than geographical location.

Other evidence demonstrating the strong correlation between class and mortality comes from Canada. Age-adjusted mortality for Canadians living in urban areas has been tracked from 1971 to 1996 by separate income quintiles. As can be seen from Figure 4, the wealthiest quintile only experienced 86% of the overall urban male mortality rate, whereas the poorest quintile experienced 123% of the overall urban male mortality rate, that is about 43% extra mortality.

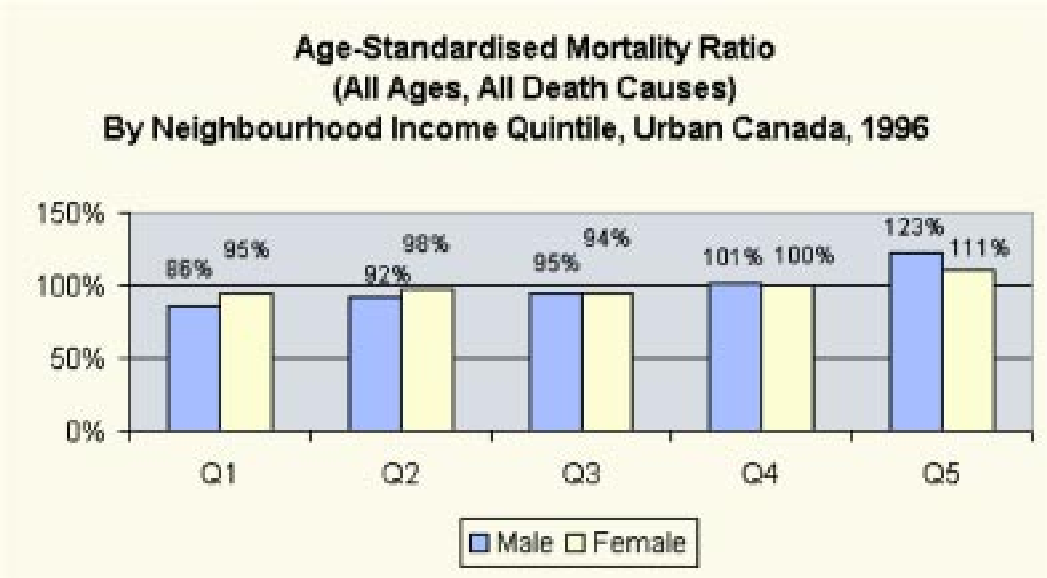

Figure 4: Canadian Male Mortality Rates by Income Quintile, 1996

Based on the above evidence, the actuary will have to estimate the variations in mortality between each of the classes he or she intends to establish. Most companies use 4 to 6 classes that separate various occupational categories. The advantage of more classes is that it possibly permits to better differentiate between occupations and more accurately assign expected claims costs to the various groups. The disadvantage is that there is it difficult to make an informed guess as to the mortality rates and to place various occupations in certain classes. By matter of convention, the best class is often called Class 1 (sometimes 1A), and higher classes use higher numerals or letters. Thus a simple classification might follow the one used in the British census surveys:

Table 7: Simple Occupational Classification Example (UK)

Class	Occupation	Examples
1	Professional	Accountants, electronic engineers
	Managerial and technical/intermediate	Proprietors and managers – sales, production, works and maintenance managers
	Skilled non-manual	Clerks and cashiers – not retail
2	Skilled manual	Drivers of road goods vehicles, metal working and production fitters
3	Partly skilled	Storekeepers and warehousemen, machine tool operators; retail clerks and cashiers
4	Unskilled	Building and civil engineering labourers, cleaners.

After determining a reasonable mortality basis for the best class, the actuary would then estimate the loadings for the other classes. This may be done by fixing the mortality for the worst class, the unskilled, as being close to, and possibly exceeding, population mortality. Mortality for classes in between would then have to be estimated based on available statistics and experience and possibly by interpolation.

Mortality also varies by type of industry. Part of the variation in mortality by industry can be explained by the greater prevalence of certain occupations within certain industries, e.g. few unskilled workers work in the finance industry. However, not all differences can be attributed to occupation.

Table 8 ranks US group experience by industry (extracted from the Society of Actuaries group study 1975-1979). The ranking is based on the upper 95% Confidence Interval of the actual-to-expected (A/E) mortality ratio (where the expected is computed using the same table for all industries). The ratios are somewhat difficult to interpret because of differences in gender proportions in each industry (e.g. services having more females than mining); possible differences in age structures by industry; and especially because the group insurance had differences in disability provisions. Despite these limitations, we clearly see differences by industry. However, it would not be surprising that differences in the prevalence certain occupations by industry would account for most of the variations in mortality. The other major factor is that accidental deaths vary even more widely by industry, and quotations for accidental death benefit cover should certainly consider industry as a rating factor.

Table 8: Society of Actuaries 1975-1979 Group Life Experience Survey

Industry	Life Years Exposed	Deaths	A/E Ratio (Observed)	A/E Ratio Upper limit of 95% Confidence Interval
Services	4,312,118	13,432	88%	90%
Retail trade	1,417,464	4,565	89%	92%
Non-classifiable establishments	487,595	2,082	89%	93%
Agriculture, forestry, and fishing	190,442	618	86%	94%
Wholesale trade	1,058,387	3,892	93%	96%
Finance, insurance, and real estate	1,829,453	5,635	94%	97%
Manufacturing	8,614,445	36,613	105%	106%
Transportation, communication, public utilities	1,411,225	5,999	106%	109%
Construction	620,793	3,037	106%	110%
Government and public administration	2,723,816	11,312	111%	113%
Mining	341,154	1,547	112%	117%
Grand Total	23,006,892	88,732	100%	

In the US, factors may range from a discount of 25% for banks to a load of 50% for mining companies, i.e. the expected claim cost of mining companies is twice that of the banks.

Thus, the actuary in India may want to construct an underwriting table by occupation and industry. This would be clearly needed for example where mortality rates vary considerably by industry for skilled manuals. For example, manufacturing could be divided between heavy and light manufacturing; or a distinction could be made between manufacturing workers and mining workers. This would then result in a table as the following:

Table 9: Simple Example of Classification by Industry and Occupation

Industry	Class 1	Class 2	Class 3	Class 4	Class 5
Light Manufacturing	Managers & Office workers	Skilled Manual	Partly Skilled	Unskilled	
Heavy Manufacturing and Mining	Managers & Office workers		Skilled Manual	Partly Skilled	Unskilled

The above table is of course only for illustration purposes. Further description would be required, e.g. lists of specific industries that make up heavy manufacturing, and a more precise occupational listing. Note that the number of classes has been increased by one to better reflect expected differences in worker mortality. Other types of workers, such as managers, may not be expected to have varying mortality by industry. Creating such tables may be an arduous task and prone to excessive subjectivity. In the end, the group actuary may have to simply make an overall adjustment to the rates based on industry.

3.6 **Location of Residence**

Differences in location also have a significant impact on expected mortality. The reasons for this are multifold, but include variations in access to health care, education levels, income levels, pollution levels, nutrition, exercise, and prevalence of personal habits such as smoking. For example, a group of factory workers in the North of England will probably experience worse mortality than an equivalent group in the south.

In India, differences in mortality levels can be noted when examining the estimated mortality rates in the year 2000 from the Sample Registration System. The mortality rates are not age-adjusted, and therefore reflect the various age distributions by state. Nevertheless, Table 10 clearly shows differences in mortality rates by state and by the urban/rural divide. Kerala, for example, has the lowest overall mortality rate (75% of the total India rate of 8.5 per mille) and the lowest rural mortality rate (70% of the total rural rate of 9.3 per mille). However, in terms of urban mortality, Kerala only has the 8th rank of the 15 bigger states (98% of the overall mortality rate of 6.3 per mille). It is interesting also to note that mortality dispersion between states is greater in the rural setting than in the urban setting. Possibly, living in cities provides a more egalitarian standard of living.

Although mortality varies significantly by state, the difference between rural and urban mortality is also significant. For example, male urban mortality is only 71% of rural mortality and female urban mortality is only 66% of female rural mortality (but this does not account for age differences between rural and urban areas). More dated data from the LIC and the 1992 SRS shows the urban to rural mortality ratio to be about 80% on an age-adjusted but unisex basis (see Table 5 – but weights were readjusted). It could be that the mortality differences between rural area and urban areas have increased over time.

Table 10: Sample Registration System Mortality Rate Estimates (2000)

Rank		Total				Rural				Urban		
		Total	Male	Female	State	Total	Male	Female	State	Total	Male	Female
	All-India Mortality Rate Per Mille→	8.5	8.9	8.1		9.3	9.6	8.9		6.3	6.8	5.9
1	Kerala	75%	83%	68%	Kerala	70%	78%	62%	Andhra Pradesh	92%	88%	97%
2	West Bengal	82%	83%	81%	West Bengal	77%	78%	76%	Gujarat	92%	91%	92%
3	Punjab	87%	87%	86%	Haryana	85%	85%	85%	Karnataka	92%	101%	78%
4	Gujarat	88%	91%	86%	Punjab	85%	88%	82%	Maharashtra	92%	93%	90%
5	Haryana	88%	89%	88%	Gujarat	89%	94%	87%	Punjab	94%	85%	103%
6	Maharashtra	88%	92%	84%	Karnataka	92%	104%	81%	Assam	97%	109%	78%
7	Karnataka	92%	102%	79%	Maharashtra	92%	98%	87%	Haryana	98%	103%	90%
8	Tamil Nadu	93%	97%	89%	Tamil Nadu	94%	98%	89%	Kerala	98%	106%	88%
9	Andhra Pradesh	96%	100%	93%	Rajasthan	96%	93%	99%	Tamil Nadu	103%	104%	100%
10	Rajasthan	100%	94%	106%	Andhra Pradesh	97%	103%	91%	Rajasthan	105%	85%	125%
11	Bihar	104%	97%	111%	Bihar	98%	93%	103%	West Bengal	106%	106%	102%
12	Assam	113%	111%	114%	Assam	108%	106%	109%	Orissa	111%	110%	108%
13	Madhya Pradesh	121%	116%	127%	Uttar Pradesh	116%	110%	124%	Bihar	113%	99%	125%
14	Uttar Pradesh	121%	113%	128%	Orissa	118%	117%	121%	Madhya Pradesh	119%	125%	108%
15	Orissa	124%	121%	127%	Madhya Pradesh	119%	113%	127%	Uttar Pradesh	127%	121%	134%

4. Computing the Total Expected Claim Costs

Once the actuary has developed a base group mortality table and various rating factors, he or she can then compute the expected individual claim cost by taking the product of the sum insured and the adjusted mortality rate. Finally, the total expected claim cost would simply be the sum of the individual expected claim costs, and its rate can be computed using the following formula:

$$\text{Total Claim Cost Rate} = \text{Total Expected Claim Cost / Total Sum Insured}$$

$$= \frac{\sum \text{Individual Sum Insured x Individual Expected Claim Rate}}{\sum \text{ Individual Sum Insured}} \quad (1)$$

The summation occurs over all participating members. The individual expected claim rate will be a function of age, gender, class, and possibly other adjustments such as geographical location.

An example of the net premium calculation is provided in Table 11. The base rates, for the best class, are 90% of the LIC 94-96 adjusted to be on an age-last-birthday basis. Other classes are loaded according to hypothetical group underwriting guidelines. In our example, females receive a 3-year age setback on male rates. The claim cost per mille is then 4.5344 after accounting for class differences.

Table 11: Simplified Example of Total Expected Claim Rate Computation

Gender	Age Last Birthday	Sum Insured	Base Rate Per Mille	Class Adjustment	Class Adjusted Rate	Expected Claim Cost
Male	43	200,000	2.4453	125%	3.0566	611.33
Female	28	100,000	1.0256	150%	1.5383	153.83
Male	25	200,000	1.0256	125%	1.2819	256.39
Female	30	200,000	1.0463	125%	1.3078	261.56
Male	43	100,000	2.4453	150%	3.6680	366.80
Male	59	500,000	11.2608	100%	11.2608	5,630.40
Female	42	500,000	1.7631	100%	1.7631	881.55
		1,800,000	4.3125		4.5344	8,161.85

Note that the average expected claim rate of 4.3125 (unadjusted for class) and the average expected claim rate of 4.5344 (adjusted for class) have been weighted using the individual sums insured. One may wonder why the class adjustment is carried directly at the individual level. For example, why not compute the base net premium (1,800,000 × 4.3125 = 7,762.50) and have an overall class adjustment? We know for example that 10 lakh of cover belongs to Class 1, 6 lakh to Class 2, and 2 lakh to Class 3. Would not the average class ratings then be equivalent to (10 × 1 + 6 × 1.25 + 2 ×1.5)/18 = 113.88888%? However, we see that 4.3125 x 1.1388888 = 4.9115 per mille, 8% higher than the real adjusted rate of 4.5344 per mille. Of course, the difference is due to the fact that class adjustments should not be weighted by sums insured alone but rather by the product of the base rates and the sums insured to account for age differences between individual members. As such, the average class adjustment would be 105.14525%, and 105.14525% × 4.3125 = 4.5344. The difference in the class weightings is accounted mostly by the 59 year old male with the high sum insured whose expected claim cost represents 69% of the overall expected claim cost (after the class adjustment).

In general, adjustments should always then be reflected at the individual level, or else appropriate consideration must be given to the effect of variations of sum assureds and ages. If the adjustment is for the entire group, such as a geographical adjustment, then this may be reflected after computing the basic group claim rate. For example, the group actuary may increase the overall rate by 5% because of its location in a certain geographical area. Whether the 5% is reflected at the individual level or the entire group level does not make a difference.

One may note a further adjustment that may be made when reviewing the example above. We can see the preponderant influence of the 59-year-old male. Had this person been somewhat substandard and been in a position to influence decisions in the company, he would have a strong incentive to obtain group insurance and avoid being underwritten. Therefore, smaller groups are expected to display greater anti-selection and as such a loading may be placed on very small groups (e.g. fewer than 50 lives). Some of the risk is reduced because the FCL is lower for smaller groups, but the expected claim cost per mille, *ceteris paribus*, would be expected to be slightly worse because of anti-selection.

In all quotations, the group underwriter should be particularly careful of groups representing special risk characteristics, especially groups in certain industries or occupations (if these are not already reflected in the group-underwriting manual). Some occupations and industries may subject their employees to higher accidental risk or to additional health hazards. For example, excessive heat or dust will result in lung damage; the easy availability of alcohol will result in higher incidences of cirrhosis of the liver; radiation or certain chemical exposures will result in cancers. Table 12 provides a non-exhaustive list of particular groups and occupations that require special attention. In some cases the insurer will have no choice but to decline to quote, or else adjust the premium for the extra risk, reduce benefit amounts, and/or ask for evidence of insurability.

Table 12: Groups Requiring Special Consideration

Type of Group	Examples
Groups facing special health and/or accidental hazards	• Workers who travel often or reside overseas • Workers in nuclear, chemical, gas, electrical, or metal refinery plants • Workers in oil-refinery or production, oil-platform workers • Miners, workers in quarries, workers involved in tunneling • Work involving explosives, ammunition, fireworks • Asbestos workers • Window cleaning and industrial cleaning • Construction/demolition workers; shipbuilding; scaffold workers; steel erectors; welders • Farmers and other agricultural workers; workers in slaughterhouses • Lumber and other forest industries • Fishermen, seamen, boat crews, dock workers • Divers • Aviation • Drillers • Boiler manufacturers or operators • Military, paramilitary, security services, policemen, firemen • Drivers (bus, truck, transport, taxis)
Any group where there is no clear employer-employee relationship or where employees are not permanent full-time employees	• Groups consisting of seasonal employees • Groups consisting of unskilled, part-time, or transient employees. • Social sector or rural groups • Part-time or temporary workers • Workers from placement agencies, or workers “on loan” • Groups with multiple employers • Social, political or religious groups or clubs • Consumer associations • Other group associations (e.g. retirees, credit-card holders, etc.) • Workers on commissions: agents, traveling salesmen • Creditor-debtor groups
Groups with special contingent risk (multiple death risk)	• Unions • Air flight crews • Professional sports teams • Expeditions • Many other of the groups listed above under “special hazards”, such as platform workers or miners
Groups where there is some possible moral hazard or extra risks	• Workers in massage parlors, baths, spas, etc. • Entertainers or Actor’s union • Workers in bars, entertainment venues, theatres, restaurants, cabarets

5. Calculating the Gross Premium

Once the expected claim costs have been determined, the actuary can then compute the gross premium. The gross premium will be the total expected claim cost loaded for expenses, commissions, taxes, required risk & profit margin, and may include a discount for investment income on reserves or cash flow.

5.1 **Expenses**

Handling of expenses will vary according to company philosophy. Needless to say, separate expense factors must be used for the group line of business. A functional cost study can determine the expenses incurred for supporting the group line. This will involve a survey of each employee to determine the tasks and time spent on group business. The group line will involve many functions, including actuarial support (e.g. product development, research and experience studies), accounting and billing, underwriting and quotations, systems development, claims investigations, contract and certificate issuance, contract administration, legal and compliance, marketing. These functions incur costs not just in terms of salaries and employee benefits, but also in technical equipment, software, office supplies, furniture, communication and transport, rent and electricity, postage and printing, etc. Furthermore, general overhead expenses may be allocated to the group line.

Expenses can then be expressed in various ways, separate for first year and renewal years. These could be a percent of premium, a percent of expected claims, a fixed amount per contract, or a fixed amount per certificate of insurance (i.e. per employee in a group). For example, a company may use a fixed expense that does not vary with group size and a percentage of total expected claim cost that decreases with group size. To the extent that it is possible, expense loadings should match the actual occurrence of expenses. Large groups may incur specific expenses and these should be reflected for each particular group.

With a new insurance company, it is inevitable that a large part of expenses will be amortized over a number of years or determined according to projected business growth.
At the end of each year, the actuary can then compare actual incurred expenses and the expense contribution of the premiums. This gap will not be a problem as long as the business has satisfied its growth targets. However, for an established company, if there is a gap it will have to be remedied either by future business growth, repricing, or expense reductions.

5.2 **Commissions**

Commissions may be a simple percentage of the premium or a fixed amount per contract or a combination of these. The commission structure and levels will vary somewhat between companies and according to market practices. The commission scale should be structured so as to reflect the actual amount of work that has been accomplished and the value of the business being acquired. Commissions may be expressed as a flat percentage of premium (where the percentage varies according to group size) or the commission percentage may be layered, as demonstrated by the example of Table 13.

Table 13: Example of Commission Structures

Commission Varying By Number of Lives		Commission Varying By Premium Layer	
Number of lives	Flat Percent of the Total Premium	Premium Layer	Percentage of the Premium Layer
Up to 50	10.0%	First INR 75,000	10%
51-100	7.5%	Next INR 50,000	4.0%
101-500	5.0%	Next INR 300,000	3.5%
501-1000	3.0%	Next INR 400,000	2.5%
1001-2000	2.0%	Next INR 750,000	1.5%
2001-3000	1.0%	Rest	.25%
More than 3000	.5%		

The layered approach does not produce some discontinuities as found in the flat percent approach.

5.3 **Tax**

In India, stamp duty will also have to be accounted for. This duty, currently set at 0.40 per mille of sum assured, is payable only at inception of the plan. Two approaches seem to have been used in the market: one is to fully and explicitly (as a separate item) charge the amount at inception of the plan and not charge it upon renewal; the other approach is to amortize the charge over 3 to 5 years, assuming the plan will remain with the company for that time (of course, the insurer pays the full tax in the year of plan inception). The second approach has the advantage of permitting the insurer to quote a lower rate at the inception of the group, but leaves the insurer with the risk that the group will not renew, and thus that the unamortised charge be paid by persisting groups.

Insurers may also price on an after corporate tax basis.

5.4 **Risk and Profit Load**

Finally, a risk and profit load will be required. The risk to the company essentially is due to mortality misestimation. Some of this risk will have been taken into account when estimating the claims cost (by building in appropriate margins), but not all. Expenses also might be inappropriately priced or estimated. Groups in a loss position may not renew with the insurer, and this forms a sort of lapse risk where the insurer is no longer able to recover these losses. All of these risks are difficult to quantify, but should somehow be reflected in the final rate.

The required return will also depend in part on the amount of required solvency that is taken up by the group business. For example, if the required solvency margin is 3 per mille of sum at risk, the premium rate before the risk and profit load is 5 per mille, and the *minimum* required return of surplus is, say, 15% before-tax, then the required profit load will be roughly 15×3/5=9% (ignoring interest on surplus).

The risk and profit load will also heavily depend on whether the scheme is participating or non-participating. This is discussed in more detail in the next section.

5.5 **Manual Rate Tables**

The generation of gross premium rates can be highly automated. Pricing parameters and factors can easily be changed to determine the impact on the premium. Tables containing gross premium rates can then be generated for specific groups. For example, Class 1 rates for various size groups can be computed, where the rates are loaded for profit, risk, tax, commissions, and expenses. Separate adjustment factors may then be applied, such as a geographical adjustment or a per policy premium load. How and when rates are disclosed to potential clients will depend on company philosophy and market practices.

5.6 **Rate Guarantees**

Group life insurance rates on an annual renewable basis are not usually guaranteed for more than a single year. If the rates were guaranteed, the insurer has in effect sold the group a put option on its claims experience. For example, suppose the first year of insurance has elapsed for a group with a two-year rate guarantee. If the group had good experience, it could always seek a new insurer possibly offering lower rates. If the group had poor experience, it would remain with the insurer at the guaranteed rate. Therefore, an appropriate loading has to be placed on any guarantees, and this loading may vary by the length of the guarantee, the size of the group, and the risk characteristics of the group. Rate guarantees are less of a concern for groups have demonstrably stable experience and where the risk of mortality misestimation is small.

6. Retrospective and Prospective Experience Rating

When estimating claims costs and determining the gross premium, the actuary may want to either (or both) reflect the past experience of a particular group or provide the group with the benefit of good (and perhaps even poor) future experience.

In the context of group insurance, prospective experience rating refers to setting a premium rate (for the prospective period of coverage) by reflecting a group's past experience, to the extent that it is credible and is expected to continue into the future. Often, we will say that the group's rate is "*experience rated*." The larger the group, and the more claims it has, the more credible will be its past experience. Thus, prospective experience rating adjusts the premium based wholly or in part on a group's actual claims experience before inception of the insurance cover.

Retrospective experience rating on the other hand refers to allowing the group to participate in the good or (possibly) the poor claims experience it will have at the end of the insurance term. Thus, retrospective experience rating will, through the use of pre-defined formulas, provide a group with some participation in the financial benefit (and possibly financial cost) of the group's actual past claims experience over the coverage term. Retrospective experience rating is carried out at the end of the period of coverage and is often referred to as *profit sharing*.

Prospective experience rating: adjust the premium using a group's actual claims experience *before the term of insurance*, to the extent it is believed that past experience is an indicator of future experience over the term of insurance

Retrospective experience rating: provide the group a financial reward (or charge) *at the end of the term of insurance* based on a group's actual past claims experience during the term of insurance

6.1 Prospective Experience Rating

The main reason to offer prospective experience rating is to quote a more accurate insurance premium for the group. Failure to carry out prospective experience rating will be to the disadvantage of the insurer for the following reasons:

- If a particular insurer fails to incorporate a group's positive past experience, to the extent it is credible, then the group in question will likely choose another insurer that will reflect this good experience. Thus, the losing insurer may find that its portfolio of groups consists of worse risks than can be supported by its premium rates.
- If a particular insurer fails to incorporate a group's negative past experience, to the extent it is credible, then the group in question will likely choose this insurer over other insurers that will reflect the negative experience. Thus, the insurer may be accepting a disproportionate number of poorer-risk groups than can be supported by its premium rates.

It is therefore imperative that the insurer correctly assesses the extent to which a group's past experience should be reflected in the premium. This assessment will be based on various considerations.

It is commonly assumed that claims in a group are independent of one another and also over time. This may be an erroneous assumption if the lives covered by a group face common hazards (such as poor work safety) or are exposed to elements causing higher mortality (such work stress or asbestos in walls). Generally speaking, the independence of claims assumption will be less valid for health covers (or other morbidity-based insurances) than for life insurance. Nevertheless, group insurance mortality will be less independent than the mortality of an individual life portfolio, and the actuary should keep this in mind when quoting for groups. In examining past claims experience, it is therefore important to look for any trends.

If the available past experience consists of *paid claims*, it is important to allocate claim amounts to the correct year of exposure: thus, for example, claims for the year 2002 should exclude claims incurred in 2001 but paid in 2002 and should include claims paid in 2003 but incurred in 2002. Incurred but not reported reserves should be taken into account if it is believed that the most recent year of experience may have outstanding claims. Further care should also be taken in calculating exposures: are the figures provided at year-start, mid-year, or end-of-year? Thus, for example, if the available claims experience consists of number of deaths, the *average* number of employees should be the basis of exposure. If a group is growing rapidly in terms of employees, it is important not to underestimate the claims rates by using the year-end number of employees.

It is also particularly important to establish the validity of past claims experience. Relying on an organization or company's own statistics is not advisable since deaths may be underreported and also because of there is a financial incentive in underreporting deaths. Similarly, relying on the sales agent for statistics is inappropriate. However, for very large organizations, it may be imprudent to ignore available experience, especially if such experience would lead to higher rates than indicated by the rate manual. Indeed, large companies with valid data may demand that they be experienced rated.

Table 14 is an example of the experience of a large group based on number of deaths and lives exposed. The last row aggregates the deaths and average employees over all years. In practice, the actuary may weight the experience by assigning lower weights to more distant years, and altogether ignore years of experience that are over five years old. Also, the actuary should try to discern whether there are any negative trends over time and reflect this fact in the quotation.

Table 14: Example of a Group's Experience

Year of Death	Natural Deaths	Accidental Deaths	Total Deaths	Year-End Number of Employees	Average Employees	Per Mille Accidental Death Rate	Per Mille Total Death Rate	Implied % LIC Total Deaths
1997	98	48	146	54,498	53,039	0.91	2.75	105.00%
1998	114	57	171	57,582	56,040	1.02	3.05	116.50%
1999	139	66	205	58,674	58,128	1.14	3.53	134.80%
2000	152	46	198	58,712	58,693	0.78	3.37	128.50%
2001	126	57	183	58,877	58,795	0.97	3.11	118.70%
Non-Weighed Total	629	274	903	288,343	284,694	0.96	3.17	121.00%

Given this experience, confidence intervals and credibility factors can then be calculated. In our example, we use the non-weighed total, although it may have been more prudent to assign lower weight to the experience of 1997, where the total mortality rate seems to have been much lower than in other years.

6.1.1 Confidence Intervals

If we assume that the number of deaths has a binomial distribution and comes from a large enough group[1], we can then build the approximate 100(1-α)% confidence intervals for mortality rates using the following formula:

$$\hat{P} \pm Z_{\alpha/2} \times \sqrt{\frac{\hat{p} \times (1-\hat{p})}{n}} \qquad (2)$$

Where we define $\hat{p}$ as the observed mortality rate, equivalent to d/n, d being the number of observed deaths and n the exposure in terms of number of lives. Also, $Z_{\alpha/2}$ is the 100(1- /2)% percentile for the standard normal distribution. Thus, using formula (2) above, we can compute the confidence intervals for the group, as contained in Table 15.

Table 15: Confidence Intervals for a Hypothetical Group's Mortality Experience

		Mortality Rates (Per Thousand)		Percentage Of Experience		Number of Deaths	
$100(1-\alpha)\%$	$Z_{\alpha/2}$	Lower Limit	Upper Limit	Lower Limit	Upper Limit	Lower Limit	Upper Limit
99.00%	2.576	2.90037	3.44328	91.4%	108.6%	826	980
98.00%	2.326	2.92667	3.41699	92.3%	107.7%	833	973
97.00%	2.170	2.94313	3.40052	92.8%	107.2%	838	968
96.00%	2.054	2.95539	3.38826	93.2%	106.8%	841	965
95.00%	1.960	2.96528	3.37838	93.5%	106.5%	844	962
94.00%	1.881	2.97362	3.37003	93.8%	106.2%	847	959
93.00%	1.812	2.98088	3.36277	94.0%	106.0%	849	957
92.00%	1.751	2.98733	3.35632	94.2%	105.8%	850	956
91.00%	1.695	2.99316	3.35049	94.4%	105.6%	852	954
90.00%	1.645	2.99848	3.34517	94.5%	105.5%	854	952
89.00%	1.598	3.00340	3.34025	94.7%	105.3%	855	951
88.00%	1.555	3.00798	3.33568	94.8%	105.2%	856	950
87.00%	1.514	3.01226	3.33139	95.0%	105.0%	858	948
86.00%	1.476	3.01630	3.32735	95.1%	104.9%	859	947
85.00%	1.440	3.02012	3.32353	95.2%	104.8%	860	946
84.00%	1.405	3.02375	3.31990	95.3%	104.7%	861	945
83.00%	1.372	3.02722	3.31644	95.4%	104.6%	862	944
82.00%	1.341	3.03053	3.31312	95.5%	104.5%	863	943
81.00%	1.311	3.03371	3.30994	95.6%	104.4%	864	942
80.00%	1.282	3.03677	3.30688	95.7%	104.3%	865	941

[1] *In standard statistical textbooks, large enough would mean in np>5 and n(1-p)>5, i.e. that there be more than 5 observed deaths in the group.*

From the above, we can see that we can be fairly comfortable with the experience of the group. Assuming of course that the data provided is complete and accurate. For example, we are 90% confident that the true mortality of the group lies within 5.5% of the observed ratio, or we are 99% confident that it lies within 8.6% of the observed ratio. As such, if the actuary were to explicitly add a 5.5% profit margin on the observed rate, then he can be 95% confident that the group will not experience a loss (looking at a one-sided probability). However, one must always be careful: the 99% confidence interval's 3.44 per mille upper limit is lower than the 3.53 rate per mille of 1999, the worst year of experience. Naturally, since then, the credibility of the group has increased, but some further analysis might be in order.

For smaller groups, the confidence intervals can be very large. For this reason, smaller groups belonging to the same class can be aggregated to estimate the appropriate mortality. This is called experience pooling.

6.1.2 **Credibility**

The actuary should also compute the credibility of the group's experience. What this simply means is putting a value on the experience of the group in order to adjust manual rates that the actuary would use for the group had there been no available past experience. Thus the expected claim cost would be a weighting of the two rates, using the credibility factor Z, $0 \le Z \le 1$, that is:

$$\text{Expected Claim Cost} = Z \times \text{Experienced Claim Cost} + (1 - Z) \times \text{Manual Claim Cost} \qquad (3)$$

The manual claim cost can also consist of, or incorporate, the pooled experience of certain groups.

Much literature on the computation of credibility factors exists and various approaches and models can be used[2]. This section however will provide a straightforward example of credibility factors.

It has been suggested that one way to compute a credibility factor is to first determine the number of claims (or, alternatively, exposures) to which one would assign full credibility. Let D be the random variable representing the number of deaths in a group of n lives with the

[2] Two approaches to computing credibility factors are the Bayesian model and the Buhlmann model. The Buhlmann model generates the best linear approximations to the Bayesian credibility estimates, and in certain conditions identical results. The mathematics of these methods is too elaborate to discuss in this paper.

probability of death being q. D is approximately Poisson[3] when q<. 05 and n>20. Therefore, the expected mean of D is λ equal to nq and its variance is also λ equal to nq.

We can then compute the mean and variance of the actual-to-expected mortality ratio (A/E Ratio). Of course, the expected mortality ratio is E[D/nq]=E[D]/nq=nq/nq=1

The variance of the ratio would be V[D/nq] = V[D]/(nq)2 = E[D]/(nq)2=nq/(nq)2=1/nq

Thus, given a certain confidence interval, the mortality ratio would approximately lie between

$$1 \pm Z_{\alpha/2} \times \frac{1}{\sqrt{nq}} \tag{4}$$

Thus, suppose that we wanted need an estimate of q that is within f% of the unknown q. How many deaths would be required for this to be valid? Using the above formula, we could solve for the number of death, after stating the desired confidence interval and the percentage error tolerance

$$1 + Z_{\alpha/2} \times \frac{1}{\sqrt{nq}} = 1 + f\% \tag{5}$$

Thus

$$nq = + \frac{Z^2_{\alpha/2}}{f\%^2} \tag{6}$$

The following table contains the number of deaths for "full" credibility depending on the desired confidence intervals and the percentage error tolerance. For example, if we considered a group to be fully credible when the observed number of deaths was within 3% of the true mean 98% of the time, then that group would need to have experienced at least 6,013 deaths.

[3] *One may also say that the number of deaths in a group of n lives with probability of death q follows a binomial distribution with mean nq and variance nq(1-q). However, for small q and given that the Poisson distribution is a limiting case of the binomial, i.e.*

$$f(x) = \lim_{m\to\infty} \frac{m!}{x!(m-x)!}\left(\frac{\lambda}{m}\right)^x\left(1-\frac{\lambda}{m}\right)^{m-x} = \frac{\lambda^x e^{-\lambda}}{x!}$$

the generated distributions are quite similar if $\lambda = nq$.

Table 16: Number of Deaths for Full Credibility, by Confidence Interval and Error Tolerance

$(1-\alpha)\%$	$f\%$									
	1%	2%	3%	4%	5%	6%	7%	8%	9%	10%
99%	66,349	16,587	7,372	4,147	2,654	1,843	1,354	1,037	819	663
98%	54,119	13,530	6,013	3,382	2,165	1,503	1,104	846	668	541
97%	47,093	11,773	5,233	2,943	1,884	1,308	961	736	581	471
96%	42,179	10,545	4,687	2,636	1,687	1,172	861	659	521	422
95%	38,414	9,604	4,268	2,401	1,537	1,067	784	600	474	384
94%	35,374	8,843	3,930	2,211	1,415	983	722	553	437	354
93%	32,830	8,208	3,648	2,052	1,313	912	670	513	405	328
92%	30,649	7,662	3,405	1,916	1,226	851	625	479	378	306
91%	28,744	7,186	3,194	1,796	1,150	798	587	449	355	287
90%	27,055	6,764	3,006	1,691	1,082	752	552	423	334	271
89%	25,542	6,386	2,838	1,596	1,022	710	521	399	315	255
88%	24,173	6,043	2,686	1,511	967	671	493	378	298	242
87%	22,925	5,731	2,547	1,433	917	637	468	358	283	229
86%	21,780	5,445	2,420	1,361	871	605	444	340	269	218
85%	20,722	5,181	2,302	1,295	829	576	423	324	256	207
84%	19,742	4,936	2,194	1,234	790	548	403	308	244	197
83%	18,829	4,707	2,092	1,177	753	523	384	294	232	188
82%	17,976	4,494	1,997	1,124	719	499	367	281	222	180
81%	17,176	4,294	1,908	1,074	687	477	351	268	212	172
80%	16,424	4,106	1,825	1,026	657	456	335	257	203	164

Groups with fewer deaths would be considered to have lower credibility, and we can set their credibility factor as

$$Z = \sqrt{\frac{d}{d^*}} \quad (7)$$

where d is the number of estimated or observed deaths and d^* is the number of deaths to which we assign full credibility. Given this simple equation, tables or graphs can be made displaying the level of credibility according to a number of deaths, as shown in Figure 5 for the highlighted values in Table 16.

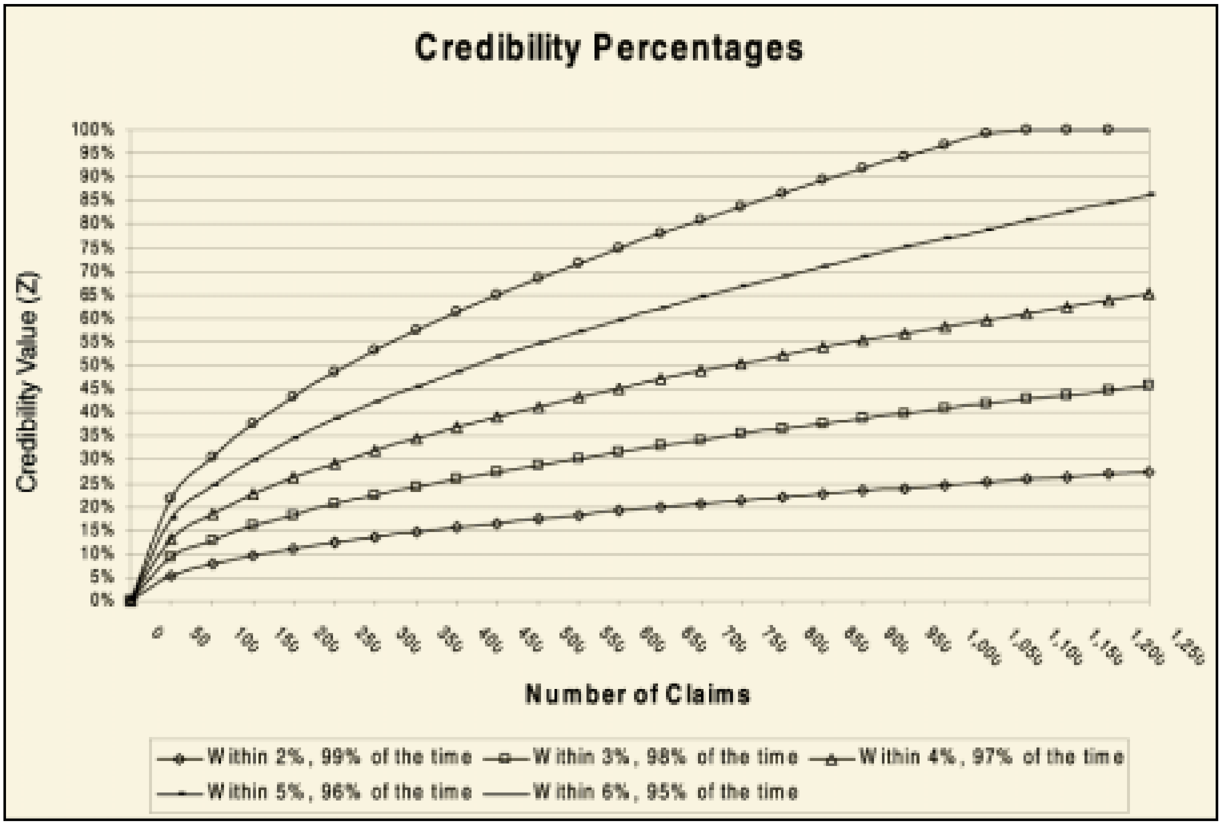

Figure 5: Credibility Factors for Numbers of Deaths at Various Confidence and Error Tolerances

For example, if a group has experienced 200 deaths, then the credibility of the group could be between 11% and 43%, depending on how strict we are in defining full credibility. It is quite clear from the graph that groups that have fewer than 5000 lives have very little credibility, since mortality rates are very low, e.g. in such a group an expected death rate of 5 per mille would only result in 25 deaths, and credibility will be less than 10%. Naturally, years of exposure can be aggregated to increase the credibility level.

If the group's experience were worse than one would expect (e.g. when compared to pooled group experience or given an estimate of the group's mortality without prior knowledge of its experience), it would be conservative to assign greater credibility than if the group's experience was better. This is reasonable given that the above formulas assume independence of deaths between individuals and over time, which cannot be said to be true, especially if a group tends to display relatively high claims rates or a negative mortality trend.

The Canadian Institute of Actuaries has derived credibility factors (for individual business) using Bayesian statistical methods and suggests that they can be used for a reasonably homogeneous portfolio. The table assigns higher credibility if a particular insurance company has worse than Canadian industry experience.

Table 17: Canadian Institute of Actuaries Suggested Credibility Factors

Number of Claims	Canadian Institute of Actuaries Credibility Factors	
	Company Experience *Better* Than Industry Experience	Company Experience *Worse* Than Industry Experience
100	0%	20%
250	20%	40%
500	40%	60%
1,000	60%	80%
2,500	80%	100%
5,000	100%	100%

From the table above, the institute assigns full credibility at 5000 deaths if the company experience is better than industry and at 2500 deaths if the experience is worse. Using the credibility formula (7) developed above, we would have obtained the following factors:

Table 18: Revised Credibility Factors Using 5,000 (for Better Experience) and 2,500 for Worse (Experience)

Number of Claims	Credibility Factor Computed Using $\sqrt{d/d^*}$	
	Company Experience *Better* Than Industry Experience	Company Experience *Worse* Than Industry Experience
100	14%	20%
250	22%	32%
500	32%	45%
1,000	45%	63%
2,500	71%	100%
5,000	100%	100%

Comparing Tables 17 and 18 shows that the Canadian Institute does somewhat apply higher credibility than the suggested factors by formula (7), although it appears the factors have been adjusted.

Instead of using number of deaths, credibility factors can also be developed for number of lives exposed or for claims amounts paid.

Naturally, credibility factors should not result in a final expected claim cost that falls outside a fairly broad confidence interval of the group's actual experience.

6.2 Retrospective Experience Rating

There has been some considerable interest in India in group insurance providing participation in the group's positive experience. There are many valid reasons why participating group insurance is attractive to both the insured group and the insurer. Among these reasons are the following:

- A particular group may consider that it is obtaining better value for the premium it is paying. That is, in the event of good experience, a portion of the excess surplus is returned to the client; in the case of poor experience, the client has received more than it has paid for.
- The opportunity to participate in excess profits may be attractive to groups with expected better mortality. This may because such groups may not be willing to cross-subsidize other, poorer-risk, groups by paying the same class rates.
- If there is greater uncertainly about mortality, the insurer has a greater security margin as a result of the extra loading to the par premium.
- The variance in claims distribution is lower for with-profit plans than for without-profit plans having equivalent expected profitability; this would reduce the insurer's variations in annual profitability.

The period of exposure after which a profit distribution will be calculated, also known as the *review period*, will depend on the size of the group. For larger groups, for example those with 5,000 of more lives, the review period will typically be one year. For smaller groups, the review period may extend up to 5 years if there is no claim pooling. The advantages of longer review periods include the following:

- They increase the number of life-years of exposure, and thus the credibility of the group's experience;
- They allow the insurer a better chance of discerning and absorbing any negative trends in the developing experience;
- In the absence of any rate guarantees, they allow the insurer to revise rates if the initial underwriting had not incorporated certain information that was either ignored or unknown before any profit is distributed.

6.2.1 **Profit Sharing Formula**

The profit-sharing formula used to determine the amount of profit to be given back to the group client may incorporate various items, as shown in Table 19 in the case of an annual distribution.

Table 19: Example of Profit Sharing Formula

	Profit Sharing Formula
	Premiums paid
+	Investment income (e.g. on the Rate Stabilization Reserve)
-	Cost of conversion charge
-	Risk and expense charge (R&E Charge)
-	Allocated claims (including incurred but unpaid claims)
-	Change in incurred but not reported claims reserve
=	Year-end gain/loss
-	Change in rate stabilization reserve
=	Total year-end gain
×	Percentage giveaway (a specified percentage of year-end gain, if any)
=	Year-end gain to client

Some comments are necessary on some of the items listed in the table.

6.2.2 **Premiums**

The premiums are the premiums paid by the group client over the year. If the premium has been paid in advance for a full year, there may be some interest credit.

6.2.3 **Conversion Charge**

The conversions charge is deducted since it is meant to cover the cost of conversions to individual policies (this cost is discussed in a later section).

The cost of conversion privileges will normally take the form of a one-time charge per 1000 of cover being converted. However, if the premium has been explicitly loaded to take into account conversions, for example by 10%, then this amount would be used as the conversion charge. The disadvantage with this approach is that it does not reflect the actual amount of coverage being converted, and so should be avoided with participating group plans.

6.2.4 **Risk and Expense Charge and the Percentage Giveaway**

The risk and expense charge is taken to cover the commissions, the underwriting, issue and administration expenses, the cost of required capital, and provide the insurer with a minimum profit margin to reflect the risk it has taken. The charge is typically expressed as a percentage of premiums, but may also consist of other items, such as a charge per claim, a charge per certificate, etc.

The *percentage giveaway* is the percentage of the excess profit that the insurer will return to the contract holder. This percentage will depend on various factors. It is clear that *all* groups contribute a risk and expense charge, but only *some* groups will have access to a portion of the excess profit that arises when claims that are lower than premium net of the risk and expense charge. Thus, the *higher* the risk and profit charge, the *higher* is the profit giveaway for a given after-distribution profit target. This will be further developed in a later section.

6.2.5 **Allocated Claims**

The claims included in the profit calculation may be the actual claims experienced by the group (called *self-experience*) or may be an allocation of partially or fully pooled claims with other groups. The purpose of pooling is to attenuate the effects of statistical fluctuations that a group experiences. This is particularly valid of smaller groups having little or no statistical credibility.

The method and basis used to allocate claims should be equitable between groups. The method and basis used should not cross-subsidize truly poorer risk groups with truly better risk groups. For example, suppose there are two *sets* of groups that are identical in all respects, such as location, gender and age, except that one set consists entirely of class 1 lives and the other set of class 2 lives. The expected claims cost for the first set of groups is estimated as 2 per mille and for the other set of groups is estimated as 3 per mille. Suppose the first set of groups experiences claims of 2 per mille, and the second set experiences claims of 2.5 per mille. If we carry out pooling by combining the sets of groups, then we could allocate, using expected claim costs as an allocation basis, $2/5^{th}$ of the total claims to the first set of groups, i.e. 1.8 per mille, and for the second set, 2.7 per mille. This approach would certainly dampen the effects of statistical fluctuations by combining experience; however, it may also be penalizing the second set of groups who *may* truly be experiencing better mortality than expected (i.e. the claims costs are misestimated for this set). Had pooling been carried out separately by occupation, the second set of groups would have received the full benefit of its experience. However, this good experience *may* also be the result of statistical fluctuations, which is precisely the reason for using pooling. Thus, pooling and claims allocation should be carried out for each occupational class only if there are enough lives in each class to make the experience by class reasonably credible.

Theoretically, pooling and claim allocation could be carried out for each possible mix of parameters used in computing the expected claim cost, such as gender, age, group size, occupational class, geographical area, and so on. However, the more there are factors, the greater is the complexity, and the more pronounced will be the effect of statistical fluctuations.

Care must also be taken in choosing an allocation basis. It would be inappropriate to simply allocated claims based on sums insured because groups will have differences in age and gender distributions. Instead, claim allocation should theoretically be carried out by using expected claims costs. If there were little or no differences in the commission, expense and profit loadings between groups of a certain category, then premiums may possibly be used as an allocation basis.

The following table demonstrates how claims could be pooled at various percentages. The percentages here vary because some groups are larger than others, and therefore would have a lower proportion of pooled claims. That is, these groups have greater credibility, and the complement to the credibility factor might be used as the pooled percentage. The example is not meant to be realistic, since groups may be pooled by size, as group size can also be a determining factor on mortality.

Table 20: Example of Claims Allocation

Group	Expected Claim Cost	Actual Claims	Percent Pooled	Pooled Claims	Remainder	Allocated Claims From Pool	Allocated Claims	Difference To Actual
1	301,887	600,000	80%	480,000	120,000	243,019	363,019	-236,981
2	377,358	200,000	80%	160,000	40,000	303,774	343,774	143,774
3	226,415	100,000	90%	90,000	10,000	182,264	192,264	92,264
4	125,786	0	100%	0	0	101,258	101,258	101,258
5	125,786	100,000	100%	100,000	0	101,258	101,258	1,258
6	100,629	0	100%	0	0	81,006	81,006	81,006
7	201,258	300,000	90%	270,000	30,000	162,013	192,013	-107,987
8	188,679	100,000	90%	90,000	10,000	151,887	161,887	61,887
9	150,943	200,000	90%	180,000	20,000	121,509	141,509	-58,491
10	201,258	300,000	80%	240,000	60,000	162,013	222,013	-77,987
Total	2,000,000	1,900,000		1,610,000	290,000	1,610,000	1,900,000	0

In any event, allocated claims should also account for reported but unpaid claims.

6.2.6 **Rate Stabilization Reserve**

When the experience is better as expected, the resulting surplus, or part of it, may be accumulated in a special account called a *rate stabilization reserve* (also known as a claims fluctuation reserve). Normally, this reserve is computed as a percentage of the premium, and will vary by size of the group. The larger the group, the lower the claims variance and hence the rate stabilization reserve may be set at a lower percentage of the premium.

If there are any losses, the rate stabilization reserve first absorbs them, and it may eventually even become negative. When the rate stabilization reserve is fully funded, then all or part of the excess profit may be paid to the policy owner. Normally, this is provided as an offset to the next period's insurance premium. If the plan terminates, the rate stabilization reserve may be paid back to the contract owner, or may be split with the insurer according to a predefined percentage.

Note that if the premium stabilization reserve is negative as a result of accumulated past losses, the insurer may try to load the premium to try to recover enough money to cover these past losses. However, the insurer will run the risk that the group will terminate the contract, especially if it can obtain better rates elsewhere. Otherwise, the insurer may absorb the loss, or part of it.

Despite the obvious advantages of rate stabilization reserves, they are sometimes not used. Note that if the rate stabilization reserve is set at zero but allowed to become negative, this is simply equivalent to a *loss carry forward*.

The rate stabilization reserve may or may not accumulate interest. Any interest would then be included in the profit calculation.

6.2.7 **Computing Loadings for Participating Business Premiums**

The participating premium loading (or par load) to the expected claims rate required for retrospective experience ratings will depend on the following factors:

- The estimated claims distribution
- The percentage of excess gains that are to be paid to the group (i.e. the percentage giveaway)

- The risk and expense charge
- The desired level of contribution to commission, expenses and profit after any distribution (we will refer to this as the target profit and expense margin, and this will be expressed as a percentage of the expected claims cost)
- The extent to which claims are pooled

Furthermore, the par load will depend on whether there is a loss carry forward (or rate stabilization reserve) for the group. If there is no loss carry-forward, there will obviously be a need to account for this. If there is a loss carry forward, the par load may be somewhat lower than if there were no loss carry forward, on the assumption that losses can eventually be recovered. However, groups in a net loss position may not renew with the insurer, and the losses would then become unrecoverable.

The main task will be to establish an estimated claims distribution. Even if we ignore for now any misestimation or trends risk, claims will vary due to statistical fluctuations. Thus, given a required profit and expense margin of 10%, the greater the number of lives in a group, the lower will be the par loading, ceteris paribus. Using the iterative method developed by Panjer[4], it is possible to generate a claims distribution that can then be used to solve for the par loadings. This method is computationally efficient and straightforward to program. It is predicated on the assumption that the number of deaths within a group follows a Poisson distribution, with mean and variance l. The method itself does not generate a distribution of number of deaths, but rather of claim amounts, from nil to the maximum possible total claims for a group. In practice, the probabilities will be generated until a certain cumulative probability is reached, such as 99.99999%

Suppose for example that we have a group with the age and amount distribution shown in Table 21. The lives with INR 100,000 insurance cover have an expected mortality of 85% of the LIC94-96; those with INR 200,000 have 80% of the LIC94-96; and finally those with INR 300,000 have 75% of the LIC94-96. These differences are meant to correspond to differences in rank and occupational class. The overall expected claims cost is 1.77 per mille.

[4] *See bibliography. The Panjer paper is also available at www.soa.org under the library.*

Table 21: Age and Amount Distribution for Hypothetical Group of Lives

Sum Insured	Percentage of Lives by Sum Insured	Age Distribution								
		20	25	30	35	40	45	50	55	60
100,000	40%	24.00%	42.00%	26.00%	7.00%	1.00%				
200,000	50%	6.00%	13.00%	18.00%	21.00%	18.00%	13.00%	7.00%	3.00%	1.00%
300,000	10%			1.00%	6.00%	24.00%	38.00%	24.00%	6.00%	1.00%

If this group consists of 100 lives, we can then generate the claims distribution as shown in Figure 6 (with mean 30,047 and standard deviation 80,311). The graph shows that in 86% of cases, there will be no death claim. The implication is clear that if profit sharing were provided, the great majority of 100 member groups would receive some profit back. Therefore, the par loading would have to be larger than the non-par loading for an equivalent target profit and expense margin.

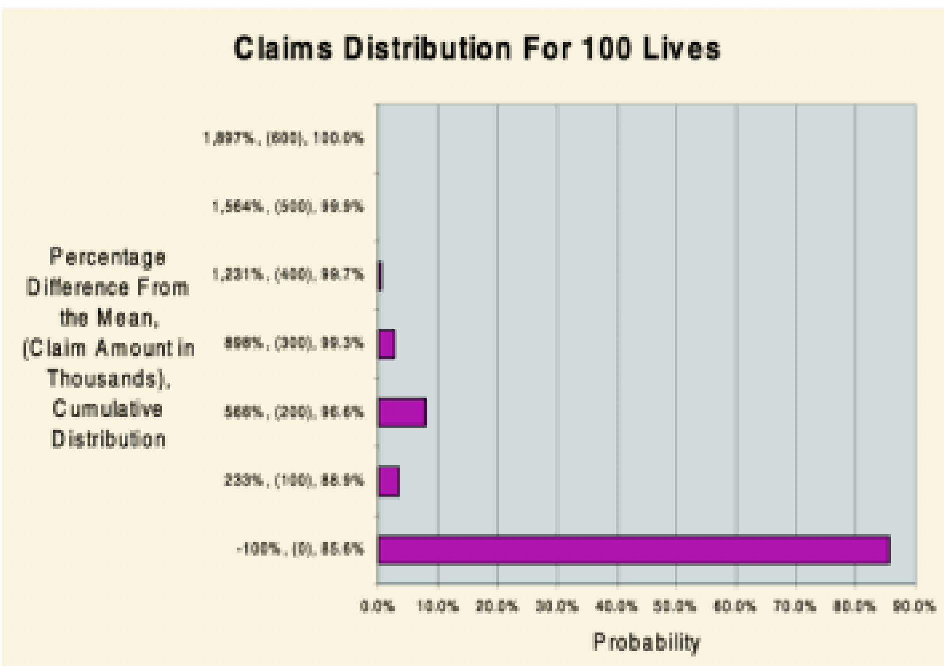

Figure 6: Claims Distribution for 100 Lives

Suppose now that the groups each consisted of 1,000 lives. We can again generate the claims distribution as shown in Figure 7 (with mean 300,471 and standard deviation 253,964). Already, we begin to see the smoothing of a curve. However, there is still a significant amount of dispersion: almost 25% of groups (i.e. those with claims of 400,000 or more) will have claims of at least 33% higher than the mean claim amount, and 21.1% of the groups will have no claims at all.

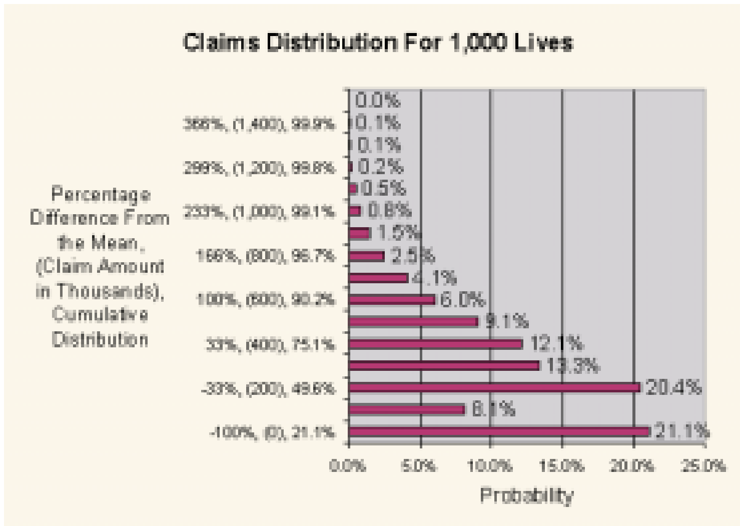

Figure 7: Claims Distribution for 1000 Lives.

Figure 8 shows the claims distribution (between .7% and 98.4% of the cumulative distribution) of groups of 10,000 lives (with mean claim of 3,004,710 and the standard deviation of 803,106). The distinct shape of a curve appears.

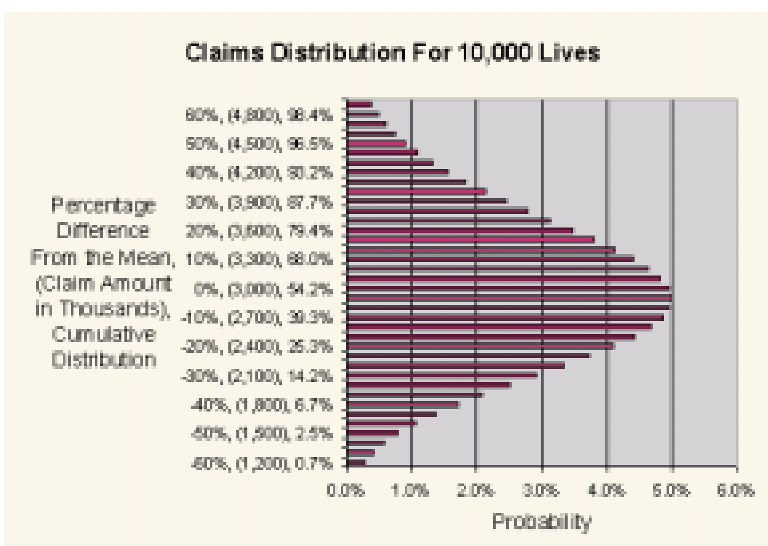

Figure 8: Claims Distribution for 10,000 Lives.

Finally, if the group consisted of 100,000 lives, the claims distribution would be as the following (with mean of 30,047,095 and standard deviation of 2,539,645).

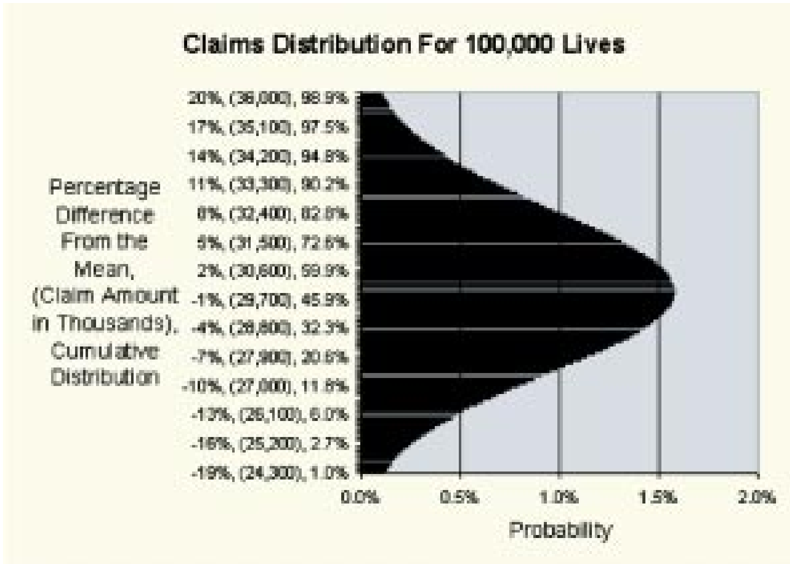

Figure 9: Claims Distribution for 100,000 Lives

From the above figures, one can clearly distinguish that the distribution of claims around the mean becomes narrower with increasing group size. The ratio of the standard deviation to mean for various group sizes can then be graphed, as shown in Figure 10. For larger groups, we can interpret this as showing that 68% of groups will experience claims within one standard deviation of the mean. For example, 68% of the groups of 100,000 lives will have claims within 8% of the expected mean.

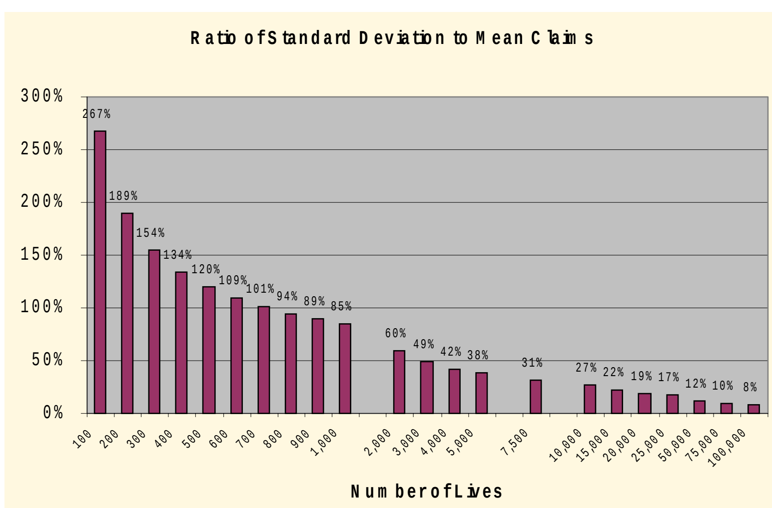

Figure 10: Ratio of Standard Deviation to Mean Group Claims by Group Size

One can deduce from Figures 6 to 10 that the bigger the group, the smaller the required par load for a target profit and expense margin. As an example, almost 86% of groups of 100 lives are not expected to experience a loss, and thus these groups will not only have to cross-subsidize the loss-making groups but also provide the insurer with its required profit and expense margin, say 10% of expected total claims costs. As the size of the group increases, cross-subsidization becomes less necessary since the distribution of claims becomes narrower, and thus the par loading to the net premium would have to be smaller in order to achieve the same target profit and expense margin.

Once the actuary has a claims distribution, it is a straightforward matter to compute the distribution of the contribution to profit and expenses. For our purposes, we will assume that the contribution to profit and expenses after any distribution is simply equivalent to the following:

$$Premium - Claims - Max\ [0;\ GiveawayPct \times ((1 - Risk\&ExpPct) \times Premium - Claims)] \quad (8)$$

GiveawayPct is the percentage of excess profit returned to the group policyholder and *Risk&ExpPct* is the risk and expense charge before the profit distribution (the items enclosed within the square brackets are a simplified version of the formula described in Table 19). Formula 8 assumes no loss carry-forward or rate stabilization reserve, no reinsurance, and no claims pooling. That is, we use this formula to determine the profit and expense contribution for a group of a specific size without the effect of loss mitigating factors. Also, please note that the risk & expense charge is not in itself a source of revenue to the insurer: it is merely used to determine the amount to distribute back to the group client. That is, if the risk & expense charge were set at a very high level, the plan would *effectively* become non-participating.

If we were to return 90% of excess profit to the group policyholder after deducting a 10% risk and expense charge from the premium, by how much should we need to load the expected net premium (i.e. the par loading) to have a target 5% profit and expense margin (i.e. to cover actual expenses and provide profit)? Looking at Figure 11, if the group consisted of 100 lives, the par loading would have to be 248.5%. If the group consisted of 50,000 lives, the par loading would only have to be 3.2%. The impact of group size is dramatic.

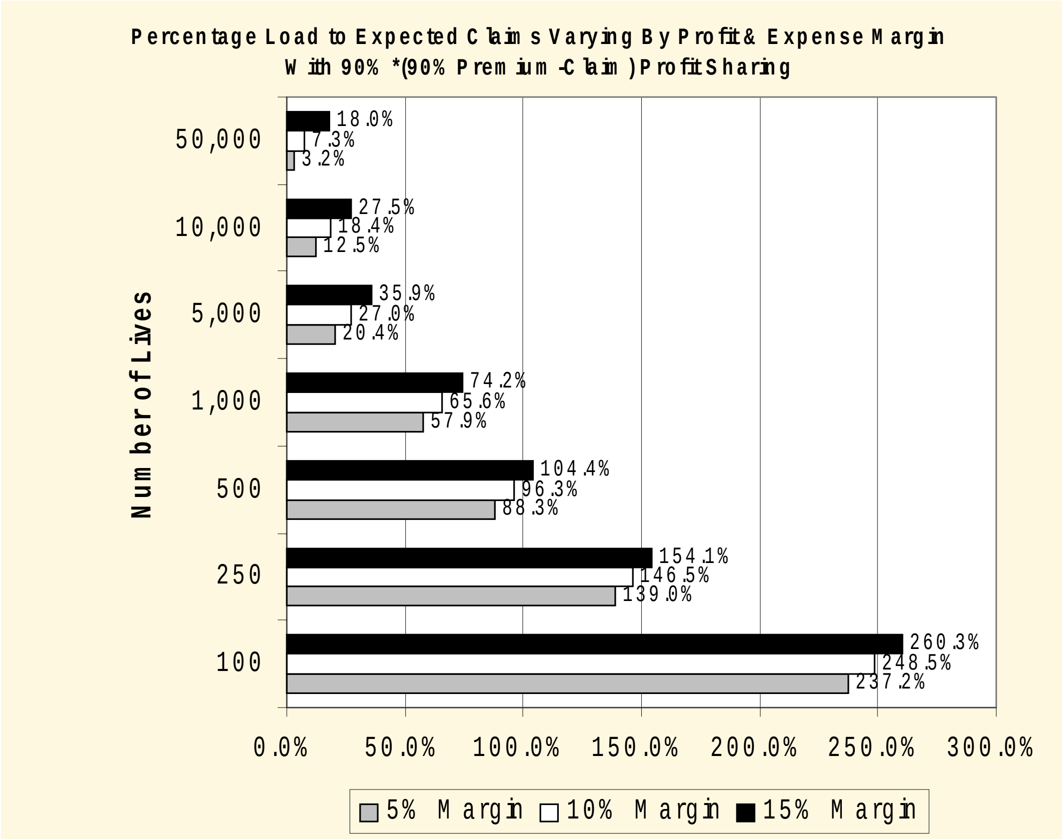

Figure 11: Required Percentage Load to Expected Claims Cost (Par Load), by Target Profit and Expense Margin, for 90% Profit Giveaway After Deduction of Claims and 10% Risk & Expense Charge.

Also, it should be noted that if we increase the target profit and expense margin, the change in par load (expressed as a percentage) is greater for larger groups. For example, for a group of 50,000 lives, increasing the expense and profit margin from 5% to 15% increases the par load from 3.2% to 18%, a 14% increase in the loaded premium (i.e. 1.18/1.032). For a group of 100 lives, the load increases from 237.2% to 260.3%, which is only a 7% increase in the loaded premium.

Naturally, this is explained in part by the level of the risk and profit charge percentage and the profit giveaway percentage. Looking at Figure 12, we can see that the relative impact of the profit sharing percentage is greater on smaller groups than on larger groups. Conversely, the impact of the risk & expense charge is greater on larger groups than on smaller groups. For example, for a group of 50,000 lives the difference in par load required to achieve a 10%

profit and expense margin is not that different whether the percentage giveaway is 80% or 90%. That is, the percentage load would only have to be raised from 2.2% to 2.6% by increasing the percentage giveaway from 80% to 90% (given a 15% risk & expense charge). If we look at a group of 100 lives only, the percentage giveaway has a preponderant impact (especially knowing that in 86% of groups of this size there will be no claim). In that case, all profit sharing formulas with 90% giveaway require a greater loading than the formulas using 80% profit sharing.

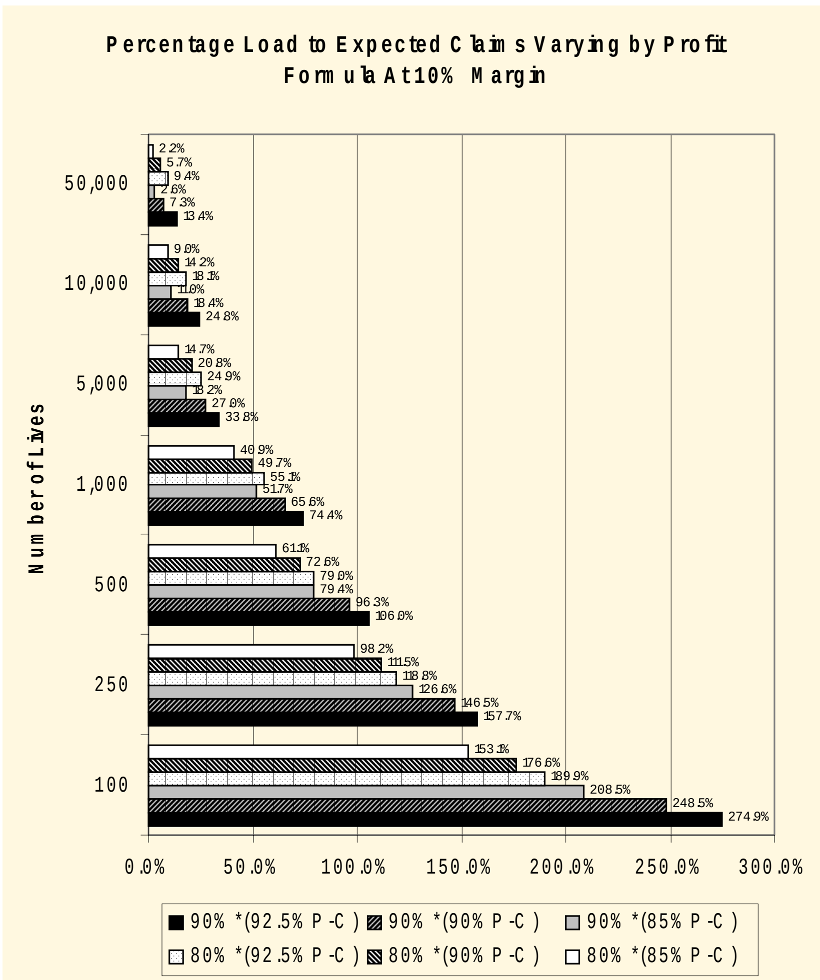

Figure 12: Required Par Load for 10% Target Expense and Profit Margin by Number of Lives and Profit-Sharing Formula

Table 22 shows the impact of exactly offsetting (in terms of percentage points) the risk and expense charge and the percentage giveaway. First, we note that the formula 80%*(90%P-C) can be rewritten as 72%P-80%C, and the formula 90%(80%P-C) can be rewritten as 72%P-90%C. Clearly, the second formula should require a smaller loading because the profit giveaway is smaller. This is true except for the group of 100 lives: this group has an 86% chance of no claim, in which case the formulas are equal, or, if there is a single claim, there is no profit sharing, and therefore the formulas are equal. The larger the group, the smaller must be the par load to maintain a 10% profit and expense margin.

Table 22 : Relationship Between Risk & Expense Charge and the Percentage Giveaway, by Group Size (at 10% Target Profit and Expense Margin)

Par-loads for 10% profit and expense margin			
Number Of Lives	(A) 80%*(90%P-C)	(B) 90%*(80%P-C)	(B)/(A)
100	176.6%	176.6%	100.0%
250	111.5%	109.6%	98.3%
500	72.6%	65.0%	89.5%
750	58.5%	50.8%	86.9%
1,000	49.7%	42.4%	85.3%
5,000	20.8%	12.7%	61.2%
10,000	14.2%	6.8%	47.9%

We can also investigate the impact of mortality variations on the par premium loadings. Clearly, as demonstrated in Figure 13, the greater the mortality, the lower is the required load for a 10% expense and profit margin, *ceteris paribus*. This is so because groups with higher mortality will have lower variation in claims distribution.

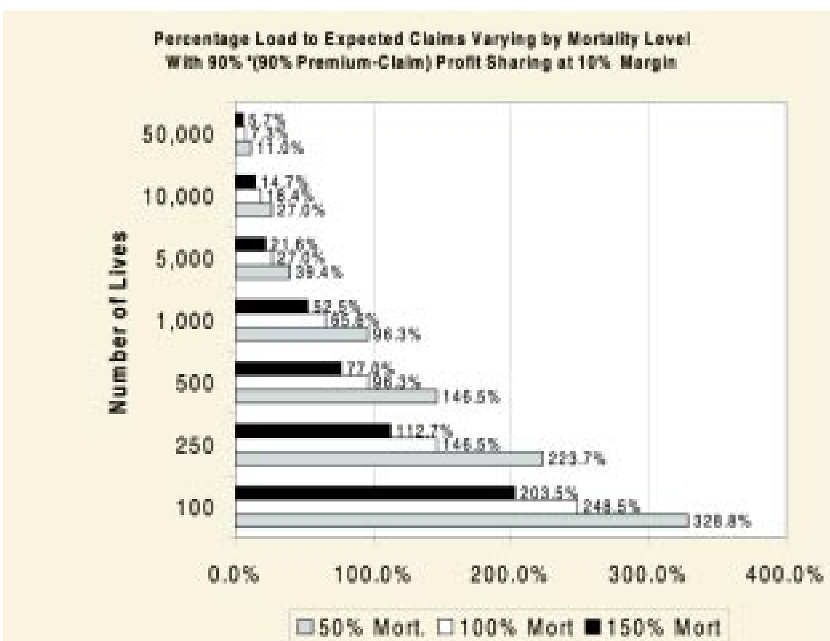

Figure 13: Required Load for 10% Margin by Number of Lives and Mortality Level

In conclusion, determining the appropriate loads for participating plans will depend on numerous factors. The actuary will have to exercise caution and carefully perform sensitivity tests. The required premium loadings shown in Figure 12 make it unlikely that profit sharing for groups of fewer than 5000 lives will be acceptable without a combination of longer review periods, higher risk & expense charges, lower profit giveaway percentages, rate stabilization reserves, and full or significant experience pooling or significant reinsurance coverage (meaning that reinsurance would have to be reflected in the profit sharing formula). The actuary could then determine the par loads reflecting these various other items. On the other hand, profit sharing may be an attractive proposition due to the smaller loads required for larger groups.

7. Group Conversions

Another aspect of group life insurance that must be carefully considered is the cost of any conversion options.

Conversion options allow members of a group scheme to convert, within certain restrictions, their group life cover into an individual whole of life or endowment policy[5]. No evidence of insurability is required at the time of conversion and the premium rates on the converted policies are based on the insurer's standard attained rates for the plan of insurance being converted to. The level of insurance of the converted policy is normally equivalent but can be lower than that of the group cover. Conversion options are not typically permitted for other types of covers, including accidental death coverage. Usually, the insured must apply and pay the first premium within 31 days of termination of employment. Certain group insured lives may also be excluded from converting, such as individuals leaving to join the armed services or persons dismissed for fraud or misconduct. The conversion option may cease at a certain attained age, for example age 55, and is typically restricted to lives accepted at the group standard rates.

Naturally, the cost of conversions will depend to a great extent on the option's conditions. Two general options can be used:

i. A generous option, which is legally mandated in the US for example, is to give the insured the right to convert to an individual life insurance policy if his or her

[5] *Another possibility is to continue the group term insurance until the normal retirement age. This is usually called a continuation option.*

coverage ceases due to termination of employment or termination of membership in an insured class. Furthermore, insured dependents may be allowed to convert their life insurance cover in the event of the death of the group insured or if they no longer qualify as dependents.

ii. A more restrictive option is to permit conversion only if the group insured is terminating employment *for reasons other than ill-health* or *retirement*. This would require the insurer to contact the employer to ensure that the employee had not taken sick or disability leave in the period prior to conversion.

The cost of a single conversion can be considered to be equivalent to:

Actuarial present value of the extra mortality cost
Less
Savings on underwriting and commissions

Once this cost has been estimated, two approaches can be used:

i. The insurer may estimate the number of lives, or amounts of insurance, that will convert and then, based on the estimated cost per 1000 of coverage amount, adjust the group premium to cover this cost, or
ii. The insurer may charge the group a fixed amount per 1000 of converted cover for each conversion, possibly based by attained age. This approach is really only practical when the group is subject to profit participation. The amount in the US is typically $55 to $75 per $1000 of converted coverage.

As a simplified example of the first method, suppose that y% of lives convert their group cover to whole of life policies and we need to determine the amount by which we will have to adjust the group claims cost rate. Let us for now ignore expenses, including savings on commissions and underwriting.

Then using standard actuarial notation, formula 9 is the approximate cost of the extra mortality per unit of converted policy, where the asterisk indicates use of substandard mortality.

$$(\bar{A}_x^* - \bar{A}_{[x]}) - \frac{\bar{A}_{[x]}}{\ddot{a}_{[x]}^{(12)}}(\ddot{a}_x^{(12)*} - \ddot{a}_{[x]}^{(12)}) = \bar{A}_x^* - \frac{\bar{A}_{[x]}}{\ddot{a}_{[x]}^{(12)}}\ddot{a}_x^{(12)*} \qquad (9)$$

If we wanted to express this cost as an increase in the group's claim cost rate, we would first have to make an assumption regarding the number of lives converting, that is, y%. Then we could solve for the z% increase in the group's net unit rate q_s^{Group} to cover this cost, i.e.

$$\bar{A}_x^* - \frac{\bar{A}_{[x]}}{\ddot{a}_{[x]}^{(12)}}\ddot{a}_x^{(12)*} = \frac{1}{y\%} z\% \times q_s^{Group}$$

or

$$z\% = \frac{y\%}{q_s^{Group}}\left(\bar{A}_x^* - \frac{\bar{A}_{[x]}}{\ddot{a}_{[x]}^{(12)}}\ddot{a}_x^{(12)*}\right) \tag{10}$$

The increase in the group net premium if 1% of group members convert is given in Table 23. In order to generate the table, certain simplifying assumptions were made. It is assumed that the average group age is the same as the age of conversion (i.e. x=s in the above formulas). This is a liberal assumption to make since converting lives would be on average probably older than the average age of the group. Furthermore, the basic mortality is assumed to be 100% of the LIC94-96 for both the individual insurance and the group insurance (in practice the basic mortality rates would be different since they are different types of insurances). The assumed interest rate is 5%.

Table 23: Cost of Extra Mortality as a Percent of Same Age Group Claims Rate for 1% Conversion Rate

Extra Mortality	Age 25	Age 35	Age 45	Age 55
Extra Mortality Is Level Forever				
25%	12%	15%	10%	6%
50%	23%	28%	19%	10%
75%	33%	40%	27%	15%
100%	43%	51%	34%	18%
125%	51%	61%	41%	22%
150%	59%	70%	47%	25%
Extra Mortality Decreases Linearly over 20 Years				
25%	2%	3%	3%	2%
50%	4%	6%	6%	5%
75%	6%	8%	9%	7%
100%	8%	11%	12%	9%
125%	10%	14%	14%	11%
150%	12%	17%	17%	13%
Extra Mortality Decreases Linearly over 10 Years				
25%	1%	1%	1%	1%
50%	2%	3%	3%	3%
75%	3%	4%	4%	4%
100%	5%	5%	6%	5%
125%	6%	7%	7%	6%
150%	7%	8%	9%	7%

Unsurprisingly, the conversion cost as expressed as a percent of the group claims rate is very sensitive to the assumed mortality assumptions. Also, to the extent that more or fewer lives convert, the ratios would be proportionally adjusted (i.e. the cost doubles if the amount being converted doubles). Offsetting this of course would be any savings on underwriting and commissions on the policies being converted to (savings in which reinsurers do not participate). Thus, the actuary needs to make several key assumptions to derive the appropriate cost of conversions.

Table 24 shows the experience of converted policies in the US. It contains the ratios of actual deaths to expected deaths based on amounts of insurance by policy year for all issue ages combined. This data is from the conversion mortality experience study from 1967 and 1977 covering the experience of 15 contributing companies. The converted policies included in the study are permanent policies issued without any health evidence. The table clearly shows that the effects of anti-selection since the mortality ratios are higher in the early durations and then taper off. Results are also compared to a previous study of 1959-1967 (although it should be noted that the two studies over the separate time periods are not comparable since the ratios are based on combined issue years and policy years that vary between the two time periods).

Table 24:US Group Conversion Mortality Experience Between 1967 and 1977 Policy Anniversaries

Policy Year	Exposed To Risk (000) 1967-77	Actual Deaths (000) 1967-77	Ratios of Actual Deaths To Expected Deaths		
			Based on the 1958 CSO Table		Based on K Tables 1967-77
			1967-77	1959-67	
1	$2,754,525	$86,319	275%	350%	345%
2	2,368,335	64,842	228%	233%	287%
3	2,167,848	51,051	187%	214%	235%
4	2,011,696	44,527	165%	193%	208%
5	1,759,649	38,167	152%	185%	191%
6	1,521,020	39,854	172%	170%	217%
7	1,309,645	34,043	162%	161%	203%
8	1,114,686	24,938	131%	162%	164%
9	928,056	23,170	136%	157%	170%
10	755,648	22,055	148%	145%	184%
11	613,010	17,148	132%	148%	163%
12	476,311	15,596	143%	145%	176%
13	368,388	10,807	119%	133%	146%
14	268,419	8,466	120%	131%	147%
15	237,924	7,650	119%	124%	146%
16	215,149	6,994	119%	122%	145%
17	192,847	6,187	116%	111%	141%
18	172,212	5,612	116%	108%	141%
19	154,652	4,631	105%	106%	129%
20	141,567	4,146	103%	104%	126%
Total	$19,531,587	$516,203	169%	176%	211%

It should be noted that the CSO 58 was the statutory valuation table at the time of the studies and for further comparison purposes the 1967-1977 evidence was restated using the proposed (at that time) K valuation tables. Of course, the experience of standard medically underwritten ordinary policies was even lower than that of the valuation tables: at the time of the 1967-1977 study, the corresponding mortality ratio was 88% of the 1965-1970 table (itself lighter than the CSO58 table). The SoA study also revealed that the conversion policies tended to have better persistency than non-converted policies, except for the first policy year (since death rates were so high in the first year).

In light of the above, the actuary should be particularly careful when designing and pricing conversion privileges for group life insurance plans. Either the group rate has to be appropriately loaded, or the group should be charged a conversion fee per 1000 being converted.

8. Group Renewal

Group renewals pose specific challenges. The primary objective is to retain the group on mutually acceptable terms. It is preferable to preempt the scheme sponsor from seeking an open market quote by being proactive, but of course this cannot always be avoided. Sometime prior to the renewal date, a representative of the insurer should contact the employer to discuss the renewal process. It is important to obtain the employer's views as to the quality of the insurer's service and to discuss/propose any modifications to the group scheme. In fact, the group renewal process should build upon the usual procedures for quoting for a new group.

The group actuary/underwriter should review the group file. He or she must first have a thorough knowledge of the scheme. Certain questions must be answered: was the initial information correct? Is the information still useful? What new information is available? In particular, the employer should have informed the insurer about all details that have changed within the previous year. That is, the insurer should ensure that it has appropriately received notification of all members who have left the scheme; changes in cover for the existing scheme members; lists of new members with all relevant information (age, benefits, etc.); individual employees' health declaration where necessary; detailed information for all claims that occurred during the previous year; and so forth. The insurer should be aware of the demographics of the scheme, not just in terms of occupational class, age, and gender, but also in terms of final participation rates; distribution of benefit levels; and whether enrolment has been steady, increasing, or declining. How have the demographics of the group changed? Basically, the insurer must be knowledgeable of what has happened over the coverage year and should seek any additional and relevant information.

Of course, it is particularly important to analyze the exposure and claims experience of the group. The depth and degree of analysis will depend on the size of the group: the larger the group, the more analysis will be required to fine-tune the renewal rate. The analysis of claims experience should of course be inclusive of reported but unpaid claims and incurred but not reported (IBNR) reserves. Claims and exposures may be analyzed by age, sex, class/occupation, location and perhaps other factors. What are the mortality experience confidence intervals and to what extent is the experience credible? How different is the actual experience from the expected mortality experience? What credibility factors should be assigned to the experience? Should there be a revision to the pooling percentage? This type of analysis is in effect not any different than for a quote on a new group for which experience is available. This work is particularly important if experience refunds are to be calculated or if there is a need for premium reductions or increases. Naturally, things may be difficult if there are catastrophic losses in the early years, or if there is evidence of anti-selection. How should the insurer deal with groups in a loss-making position? Should it try to recover past losses by including an additional load to the premium? Doing so may force the group to lapse. The poor experience, for small groups, might just be the result of statistical fluctuations and should not warrant a change of rates unless the pooled experience is credible and has changed.

Once this claims analysis has been performed, a good estimate of the renewal rate can be arrived at. However, one potential problem relates to timing: the claims data is normally not fully available due to reporting delays, and this complicates giving the employer adequate notice of new rates. It is also difficult to estimate reserve requirements since the claims data is also incomplete. One should look at the delays between the date of death and reporting dates to adequately set any IBNR reserves.

The employer should have received periodic experience reports in the year of coverage, so there should be no surprise as to any rate change. However, if the renewal premium is much larger than previously, the group actuary/underwriter must decide whether to recover past losses all at once or over a few years. This is particularly problematic if the original underwriting was based on overly optimistic claims assumptions or marginal administrative costs.

Sometimes the group scheme sponsor may want to discuss changes to the design of the scheme, such as desired profit-participation or partial self-insurance. The insurer should be prepared to discuss these options and provide terms, or otherwise risk losing the scheme. Also, as a result of employer budget constraints, there may be a need to introduce a voluntary plan or, if the plan is already voluntary, to increase employee cost sharing. The employer may also desire higher FCLs or additional rider coverage. Again the insurer must be prepared to handle these requests. The insurer itself may have modified its group underwriting guidelines and practices, and may want to introduce some changes to the scheme to reflect these modifications.

The renewal process also permits the insurer to review its internal processes, such as to ensure that underwriting guidelines were properly applied and that administrative procedures are efficient.

In the end, quoting for a group renewal is not so different than having to quote on a new group except that more information is available and some relationship already exists between the insurer and the scheme sponsor.

9. Reinsurance

No matter the type and amount of reinsurance, the costs and benefits of a reinsurance treaty must appropriately be reflected in the group schemes' pricing and design. If the groups are participating, reinsurance could be reflected in the profit-sharing formula. The reinsurance may itself be participating, independent of whether the underlying groups are retrospectively rated. Normally, the reinsurance profit sharing arrangement with the insurer includes all reinsured lives of all groups covered by a treaty, except for facultative underwritten lives. There is also a minimum number of cessions before profit-sharing takes effect. Also, in special circumstances, or for large groups, the reinsurance profit sharing may be per group.

9.1 **Proportional**

Group schemes can be reinsured using quota-share or surplus arrangements on an annually renewable basis. The group insurer's retention will depend on insurance regulations and the degree of comfort the insurer has with its projected claims distribution after reinsurance. The more business is reinsured, the narrower will be the insurer's claim distribution. At an extreme, if all group business were reinsured, the insurer would have replaced an uncertain total claims amount with a certain reinsurance premium. Using the method proposed by Panjer, it is fairly straightforward to generate claims distribution including the mitigating effect of reinsurance.

Reinsurers' rates will of course be set to cover the reinsured risks and provide some profit after expenses. In the case of a quota-share arrangement, both insurer and reinsurer bear the same mortality risk; however, in the case of surplus reinsurance, the reinsurer may be reinsuring many more company directors with a (possibly) higher risk profile due to anti-selection. Also in the case of a surplus arrangement, the reinsurers' experience will not be as credible as that of the insurers since many fewer lives are reinsured. As such, a reinsurer may not be able to justify revising rates as quickly as an insurer. Furthermore, in the case of a surplus treaty, automatic increases in sums assured, for example as a result of promotion or increase in salary, would disproportionably affect the reinsurer.

9.2 **Non-proportional**

Of particular utility in the group business is *catastrophe cover* that provides the insurer additional protection on the risks within its retention. This type of reinsurance limits the cost of multiple claims as a result of a single incident, such as a natural disaster or an accident. The contract stipulates the number of deaths that must occur for payment to be made. The contract also stipulates the amount of the claims that the insurer will first have to pay, called the *priority*. For example, the reinsurance contract will stipulate that 5 or more deaths must occur for the catastrophe cover to take effect, and that the insurer will first pay up to 800,000 in claims before the reinsurance pays for claims in excess of the priority. The insurer's priority is normally a multiple of its retention. In our example, if the insurers normal retention is 200,000, then a priority of 800,000 does make sense, in that the net cost to the insurer for 4 deaths would be, at maximum, 800,000, as would the cost for more than 4 deaths. The reinsurer however will not pay an unlimited amount under catastrophe covers: there is both a maximum amount per catastrophe and a maximum cap for all catastrophes within a year. Other reinsurers may provide additional capacity to cover these limits.

The contracts are renewed annually and rates are usually quoted per million of self-retained business. Special rates apply to groups with contingent risks, such as firemen, policemen, oilrig workers, and so on. Also, there are normally exclusions for epidemics, wars, and possibly terrorist acts.

Another type of non-proportional reinsurance is stop-loss reinsurance. This means that the reinsurer will pay all or a portion of claims in excess of a stipulated amount that is a multiple of an insurers' expected total annual claims, for example 120% of total expected claims. In effect, the reinsurer is covering a portion of the right side of the insurer's claim distribution.

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