Presented to the Staple Inn Actuarial Society

on 5th January 1988

COMMERCIAL FIRE INSURANCE

Author:

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"The author has no doubt .....that the time is approaching when..... the present loose and almost undefined method of estimating [Fire Insurance] premiums for different kinds of risks will give place to one of a more scientific and definite nature."

Preface to "The Theory and Practice of Assurance" (1847) by W E Hillman, Actuary to the Star Assurance Office.

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1. SCOPE AND OBJECTIVES

The General Insurance Study Group commissioned a paper on fire insurance for presentation to their Windermere conference in October 1986. This current paper is a shortened and updated version of the original paper, which is available from the Institute library. PAPER 3 (RKN 610)

The authors feel that the level of knowledge of commercial fire insurance is relatively low within the actuarial profession. This may be a relevant factor contributing to the recent decline in numbers of specialist general insurance actuaries within the larger composite companies. Actuaries may have entered the arena with some worthwhile ideas on reserving, statistical analysis and motor rating. However, while their ideas in these areas have been refined over the years, they have never made the important transition into the centre of the general insurance stage within the direct writing companies. This would involve contributing ideas within the commercial insurance field and considerable contact with underwriters. The paper portrays a diversity of thinking between actuaries and underwriters and the authors feel that actuaries have a lot to offer in this area.

In many ways this is a "chicken and egg" situation. Actuaries cannot be helpful to commercial underwriters until they are involved in and understand the business; yet they are unlikely to be involved in the business unless they can be helpful to underwriters. It is hoped that this paper will be a start in helping to break the vicious circle.

With the above thoughts in mind the authors have produced this basic educational paper on commercial fire underwriting - a class of business which covers any property except domestic dwellings. Such business produces nearly £1 billion worth of premium in the UK alone. Although the paper does give background information, particular emphasis is given to areas where actuarial ideas could be most profitably employed. These could perhaps be developed in later papers. Similar work could also be usefully done in other areas of commercial insurance business.

The paper concentrates on direct business in the primary insurance markets. Much interesting work could be done on the different aspects of fire cover in the reinsurance and in the London market; however this is outside the scope of the current paper.

2. FIRE INSURANCE

2.1 Scope of Cover

Basic Cover

Since 1922 most leading insurance companies have adopted a standard form of policy; the smaller companies, however, have tended to follow broker wordings. This has led to a uniformity of cover and limitations and also of conditions and their interpretation. Following dissolution of the Fire Offices Committee (FOC) this uniformity may diminish as new wordings appear although the Association of British Insurers (ABI) has prepared recommended wordings for its members. The standard policy covers the property against:-

Fire (whether resulting from explosion or otherwise) not occasioned by or happening through:

(a) Its own spontaneous fermentation or heating or its undergoing any process involving the application of heat. [That is to say that the material undergoing such a process is not covered although the damage caused by a resulting fire is].

(b) Earthquake, subterranean fire, riot, civil commotion, war, invasion, act of foreign enemy, hostilities (whether war be declared or not), civil war, rebellion, revolution, insurrection or military or usurped power.

Lightning

Explosion, not occasioned by or happening through any of the perils specified in (b) above:

(a) Of boilers used for domestic purposes only.

(b) In a building not being part of any gas works, of gas used for domestic purposes or used for lighting or heating the building.

The conditions of the policy exclude other types of explosion, nuclear risks, property insurable under a marine policy, and unless specifically mentioned, goods in trust or on commission, and items like money, documents, plans etc.

The wording of the Lloyd's Policy is similar but slightly wider.

Fire implies actual ignition and must be accidental in origin from the point of view of the insured. Damage to the insured property caused by measures taken to put out the fire, and through such associated occurrences as smoke, scorching or falling walls is covered. Arson (or wilful fire raising in Scotland) is also covered, provided it is not committed by, or with consent of, the Insured.

A standard specification identifies the property covered and would list

a) The building, including landlords' fixtures and fittings

b) Machinery, plant and all other contents

c) Stock and materials in trade

Other specific items of property may be added to this list. Memoranda would generally be attached to this specification to define more closely the cover given. Special clauses may be added to the standard policy to cover items like computer systems records, the fees of professionals (eg architects and surveyors), costs of complying with the requirements of public authorities, and property while temporarily removed.

Additional Cover

Cover may be bought for damage caused by:

a) Dry perils like explosion, aircraft, riot, impact, earthquake, subterranean fire, subsidence or landslip and spontaneous combustion.

b) Wet perils like storm, tempest and flood, burst pipes and hail.

c) Sprinkler leakage.

"All Risks" policies are also available and they offer cover not only against named perils but against accidental loss of or damage to the property insured from any cause other than those individually excluded in the policy wording.

Consequential Loss

Whereas the fire policy provides protection against destruction of or damage to buildings and contents a CL policy protects the earning capacity of the business. It makes good the loss in profits while the premises are being rebuilt and the machinery and stock replaced. A range of perils can be covered and it is common for the corresponding Fire policy to have at least that range. The cover is normally for a 12 months indemnity period but covers for 18, 24 and beyond are available. The indemnity period begins with the occurrence of the damage and ends not later than the maximum period selected during which the results of the business are affected by the damage.

Consequential Loss is also known as business interruption (BI). This paper does not consider consequential loss policies in any great detail.

2.2 Bases Of Cover

Indemnity

The measure of the office's liability is the value (after depreciation) of the destroyed property at the time of the loss or the amount of damage if lower. The sum insured should therefore represent the value of the property.

Reinstatement

This is available for buildings and machinery (but not for stock) and the insured receives new for old without any deduction for depreciation. Destroyed property is rebuilt or replaced by similar property. For damaged property, the damaged portion would be repaired and restored.

First Loss

The sum insured is restricted, with the office's agreement, to a figure less than the full value of the property. It represents the maximum value the insured considers vulnerable to a single loss. It is used usually where there is no possibility of the building being reinstated (eg stately homes) or for insurances covering water damage.

2.3 Aspects of Cover

Average

To encourage full insurance and to ensure as far as possible that each insured pays an equitable premium the condition of average is applied to virtualy every insurance other than first loss covers. It requires the insured to bear losses in proportion to the level of under-insurance.

On reinstatement policies, the sum insured at the time of destruction of or damage to the property is compared with 85% of the figure necessary to reinstate the whole of such property at the time of reinstatement. Only if the sum insured is less, does average apply.

Allowance for Inflation

Adequate sums insured must be maintained and it is not only necessary to provide for inflation during the policy period but, in the case of reinstatement policies, also during the period required to reinstate. The 85% rule mentioned above acknowledges the difficulty of predicting future inflation.

Various schemes for inflation provision have been devised and these generally apply to buildings and machinery. A base sum applicable at the beginning of the period of insurance is chosen and an additional sum is incorporated to make some allowance for inflation up to the end of the period of insurance or up to completion of reinstatement. This additional sum is at a lower rate % and there may be an adjustment to the premium at the end of the period of insurance.

Allowance for Self-insurance.

Besides retaining a proportion of the risk, the insured may bear part of a loss through a:

a) Compulsory excess. This rarely applies to the fire perils but is invariably imposed for the wet perils and on "all risk" cover.

b) Voluntary excess or deductible. In this case the insured is granted a reduction in premium. The deductible can range from £250 to £50,000 and even more and discounts from 5% upwards. With a substantial deductible, sometimes applying to both material damage and consequential loss covers, an aggregate deductible of say 4 times the deductible may be agreed. (An aggregate deductible is one that applies to the total of all claims in a given period).

c) Franchise. In this case, provided the claim exceeds the franchise amount then the full amount is paid. However, this method is rarely used.

2.4 Aspects of Market Practice

Collective Policies and Coinsurance

Large commercial risks are often co-insured, the coinsurers contributing to all claims in the proportions of their participation in the insurance. The office with the largest proportion, the leading office, surveys the risk if necessary prices the cover, administers the insurance and prepares the documentation.

Long Term Agreements

The office offers a 5% discount to the insured if he agrees to renew his policy for a term of three (or somtimes five) years and signs an agreement to that effect. The office is not bound to accept the offer of insurance at the renewal date. It may want an increased premium in which case the insured is not obliged to renew.

Blanket Policies

These show only total sums insured in each of the 3 categories (ie buildings, contents and stock), for firms with works and warehouses spread over more than one fire risk.

Declaration Policies

These cater for businesses where stock values fluctuate. The sum insured chosen is the maximum likely to be at risk during the year and at regular (say monthly) intervals the insured declares the value at risk. An initial deposit premium is paid and there is an adjustment at the end of the year. The need to amend the sum insured from time to time to accommodate fluctuations in value is thereby obviated.

2.5 Estimated Maximum Loss (EML)

One definition of EML is: "It is an estimation of the most serious loss from a single occurrence that can reasonably be envisaged (or, is within the realms of probability) from any peril. In the case of fire/explosion, the factors of construction, sub-division of the risk, occupation and hazards pertaining to the risk at the time of examination are considered but sprinkler protection and other automatic prevention or extinguishing arrangements are ignored." EMLs are equal to the sum insured in the case of small buildings but in large modern office blocks may be only 10% of the sum insured.

The EML helps the underwriter to determine, in the light of reinsurance facilities available, the extent of his acceptance and may also influence the rate he charges.

3. THE UNDERWRITER'S PERSPECTIVE

3.1 Introduction

This chapter and the next give a view of fire insurance underwriting and rate setting through the eyes of an underwriter. Actuaries wishing to enter the fire insurance area need to appreciate that the underwriter may look at his business in a different way to the way an actuary would see it. These differences are discussed in chapter 5.

3.2 The Influence of the Former Tariff

Fire underwriting is a discipline with a strong tradition. Because of the long history of the FOC (Fire Offices' Committee), to which most of the leading fire offices belonged, and the 120-odd years of its Tariff, there is a coherence to fire underwriting thought which runs virtually across the industry. The unity is much greater than one would find, say, in liability insurance or personal accident and applies even to those offices which were non-Tariff, since they were strongly influenced by its existence. Although proclaiming independence, many would follow the same rating structure, and might even be in possession of under-the-counter copies of the Tariff itself!

The Tariff, which was finally abolished in mid-1985, comprised a set of basic rates, on a trade or industry basis. To these, various adjustments were prescribed according to the particular features of a risk, and the warranties which an insured was prepared to undertake. The schedules were based more on underwriting 'feel' than exact science, but nevertheless incorporated many years of business experience. As a result, at the overall level, the Tariff was successful in prescribing premium rates that gave offices a very adequate level of profitability. But it was not always so satisfactory in terms of fine tuning, and some problems were experienced with the system as the 20th Century progressed into its later years.

These problems related mainly to the lack of flexibility of the Tariff. The industrial scene was changing, and the effort of incorporating whole new industries into the structure proved too great. The commercial market was changing with such rapidity that there was no hope of keeping the Tariff rates up to date, other than by a crude system of overall adjustments. Most important of all, commercial fire became very competitive. Offices would have to fight at each renewal to retain their business. Even those which were FOC-diehards had to permit exceptions to Tariff ratings, or lose substantial premium income.

Hence there were good commercial reasons, as well as political ones, for the eventual disbanding of the FOC in 1985. But though the formally agreed rating structure may have gone, there is a continuing legacy from the Tariff era. The way of thinking that lay behind it will remain a strong influence for many years to come.

3.3 Surveys

The assessment of the risk is made on the basis of information gathered from the proposal form, supplemented in larger cases by a broker presentation. In addition the office usually gets a specialist fire surveyor on its staff to physically examine the risk. These surveyors are generally people with a good practical knowledge of fire technics, detection and prevention and, of course, fire insurance, rather than necessarily professionally qualified as a surveyor. As a by-product of their report to the underwriters the surveyors check up on whether warranties or conditions in existing policies are being obeyed and generally make recommendations of ways in which the risk can be improved.

3.4 Treatment of Substandard Risks

The underwriter's aim is to take on risks, but only those he would regard as "reasonable". When a proposal comes in, he will look for any bad features present, and place each on a scale of ascending severity. If the features are minor ones, he may ignore them, or introduce a small loading to the premium, and so on up the scale as the severity increases. But eventually he will reach a point where the hazard is so great that he feels that the risk is not commercially viable to his company. By the law of averages, ultimately, there will be a loss which is far greater than the premiums paid.

To put the point in figures, if there is a 100% chance of a total loss within 10 years, or a 10% chance of such a loss in any one year, then the risk is considered to be quite beyond the pale. Insurers will generally not wish to charge more than say 2% as a premium in the property market. A risk, then, may be uninsurable as it stands. The question is, can it be improved so as to bring the premium rate down to the "reasonable" level? If so, then terms may be offered, and a contract negotiated. The classical answer is to have sprinklers put in, and then reduce the effective rate by 50% or more. But there are aspects of risk more difficult and perhaps impossible to deal with. Moral risk is the prime example (see section A1.4).

As a means of control on poor risks that are acceptable, the underwriter will frequently impose a lower acceptance limit than normal. That is, he will restrict the amount of cover given. Consequently, a poor risk is more likely to need co-insurance, with a number of companies each underwriting a proportion only of the sum insured. In such cases, the influence of a competent broker with good market contacts may be essential to the placement of the risk. The key, perhaps, lies in the proposer's attitudes - if these are acceptable, then attempts will be made to take part of the risk by the underwriters concerned.

3.5 Underwriting vs Insurance Profit: Investment Income

Traditionally underwriters ignore investment income and work in terms of underwriting profit. There are good reasons for this. For example, in a large organisation with many branches involved in underwriting, clear instructions have to be given to the staff. To them, the term "underwriting profit" will have a direct and simple meaning, and will help to guide the course of their work. Staff would not fully understand the concept of "insurance profit", nor how it is arrived at by an actuary. Hence direction and momentum will be lost, and with them, perhaps the chance of making any profit at all.

If premium income can be expected to cover claims, expenses and a margin for profit, then investment income may be used for building up the reserves. This strengthening is particularly desirable under modern conditions, so that solvency margins can be maintained at an adequate level as the business grows. Also, as time goes by, the individual risks are tending to become much larger in size, so that a stronger capital base is needed in order to give the proper cover.

3.6 Trends in Risks

The trend towards larger risks is an easily observable one. There are nowadays more 'ostrich eggs' in the nest, in comparison with the ducks and chickens of yesteryear. The effect comes simply from the industrial trend towards larger units with greater concentrations of valuable equipment - computers, aircraft, chemical plant and so on. A modern shopping complex would be another example.

The losses which occur in such cases can be extremely large, eg. Donnington ordnance depot (£165m), Cricklewood warehouse fire (£49m), BAC at Weybridge (£72m), etc. It seems that there is a functional relationship between increase in square footage and increase in EML, and that the function is more geometric than arithmetic in character.

A second significant trend is towards greater moral hazard - damage resulting from arson and other wilful types of vandalism, together with lax standards of discipline, security and management control. Poor housekeeping is on the increase, and appears to have been a contributory factor, e.g. to the Bradford Football Club disaster of 1985.

3.7 The Underwriting Cycle

For the underwriter the most important point of all is that while there is one truth to be found in statistics, there is another to be found in the market place.

Market conditions heavily influence general insurance rates and the fire underwriter disregards them at his peril. Competitive pressures give rise to the underwriting cycle, a phenomenon which can be described in classical economic terms. In the early 1970's, there was a hardening market, reaching its peak in 1972/73. Premium rates were relatively high, and good underwriting profits could be made. New companies were attracted to enter the market and established ones increased their capacity for business. Soon the market was overprovided, competition intensified and premium rates began to fall. This led to a protracted soft market in the later 1970's and early 1980's. By the end of the period many companies were suffering substantial losses. Some reduced their capacity, while others left the market altogether. This led to the opposite aspect of the cycle, and in 1984/85 the hard market reasserted itself. Premium rates were restored to higher levels relative to risk, and those companies left in the market returned towards a position of underwriting profit.

A significant aspect of the recent hardening of the market has been the drastic reduction in reinsurance capacity. This feature has particularly hit the smaller companies, and largely destroyed their ability to undercut the bigger, better established offices. Thus, in the soft market, a small company could write large tranches of business far beyond its own capacity, simply by reinsuring the greater part away - in some cases 95% and more! That option is no longer open today.

There is a corollary to be drawn from the underwriting cycle. It is that, in the soft years, an office may deliberately take or retain business, knowing that the rate set is not a profitable one. This is because it has a feel for the cycle, and wishes to keep the business on its books for the hard years which are likely to follow. The aim is to make a good profit in the longer term, and not just for the current year in isolation. Even so, the prudent underwriter will have some lower rating limit in mind, below which he will not be prepared to go in the competitive scramble.

4. OFFICE RATING PRACTICE

4.1 Introduction

The original paper included a survey of 7 offices' rating structures. The survey showed much variety in the practical detail but considerable uniformity of underlying principle. The method used by one of the offices is reproduced here because it gives particular insight into the underwriter's approach to rating.

4.2 Office X's Rating Method

Rating Basis & Risk Classification

Rates are expressed as a percentage of sum insured. In most cases, but not all, the same rate applies to buildings as it does to contents & stock. The rates, which operate on a trade or industry basis, are derived partly from detailed internal statistical analyses. They have also evolved from the underwriters' judgment over years of experience, and from market considerations.

Risks are classified by the trade of the occupier of the building, using approximately 50 main classes. The grouping is by the underwriters' perception of the similarity of the risk as translated into premium rate terms. As a result, many members of a class are clearly related (e.g. manufacturers using similar raw materials) - but many others are completely unrelated (e.g. manufacturers, retail shops, public buildings).

The classification also contains groups of trades which are undesirable from the insurer's point of view. These are subject to automatic refusal, or acceptance only in exceptional circumstances, e.g. because the fire cover is part of a package. A further group defines difficult trades which must be referred from the branch office to Head Office for consideration by the office's most senior underwriters.

Rating for Fire Risk

The tabular rate for a given class is usually a range, within which a rate has to be selected by the underwriter using his judgement. The range between the minimum and the maximum rate varies between classes. In some classes the range is nil, while in others the maximum is between 1.25 and 4 times the minimum. In one exceptional case it is 6 times.

Within the range, the underwriter has considerable scope for judgement. Apart from the proposal form itself, his main source of information on the risk will be the Fire Surveyor's report. He will adjust the rate upward or downward according to a number of key features of the risk revealed by the report, including the following:

a) Construction of building. (Combustability of materials, likelihood of collapse in a fire, etc.)

b) Factors contributing to rapid fire spread. (Undivided roof, unprotected stair wells, etc.)

c) Methods of space heating. (Gas or Oil fired heating, portable burners, etc.)

d) Management and Housekeeping. (Clearance of trade waste, no smoking regulations, security of premises, etc)

e) Special storage arrangements. (Compartmentation, height of stacks, etc.)

f) Fire Extinguishing appliances. (Presence or absence of sprinklers, direct fire brigade links, etc.)

The adjustments may overlap in their effect on the underwriter's selection of the rate within the tabular range.

Finally, the office considers market conditions and this may result in further adjustment to the calculated premium. In making this adjustment the office takes into account the past experience of the risk.

In practice the selection of the original rate and the various adjustments tend to be combined in one thought process and in any case only the final premium is recorded.

Rating for Special Perils

Both wet and dry perils are rated independently of the fire risk, using a further set of tabular rates. These rates vary by sum insured: the higher the sum insured, the lower the rate. A separate rate is provided for each peril to be covered, though rates for a combination may be less than the sum for the individual perils. The resultant rate for special perils is added on to the main fire premium rate.

4.3 Comparison of Office X with Other Offices

Some offices rate separately for buildings as opposed to contents & stock, while some take the two categories together. But, like Office X, they invariably use a rating structure which is based on a trade classification, and apply the resultant rates to the sum insured. The main differences lie in:

a) the degree of central control,
b) the number and complexity of the risk features,
c) use of special procedures such as EML or experience rating.

On the issue of control many offices exercise tighter supervision than does Office X. Thus, Head Office will lay down standard rates for each trade, rather than allowing ranges. Particular features of a given risk, as evaluated from the surveyor's report, will then lead to various loadings and discounts being applied to the standard rate. These discounts and loadings may again be standardised, leaving the branch underwriter with little discretion.

Secondly, on the number and complexity of the risk factors taken into account, there is a good deal of variety between the different offices. A description of the range of factors which may be used is given in appendix 1. Since the demise of the Tariff, offices have tended, if anything, to simplify their rating structures and to reduce the number of factors used.

Finally, special procedures. Perhaps surprisingly, EML appears not to be used as a rating factor by the majority of offices. But when it is, the principle is simply that rates are increased step by step as the proportion of EML to the sum insured increases. As for experience rating, this may or may not be used. Where it is, a common practice would be to give discounts for a low 5-year loss ratio, the level of discount increasing with the size of risk.

4.4 Experience Rating

At one extreme are cases where the experience of the individual risk is ignored in setting the premium for it. These are likely to have premiums below £1,000. They may be described as tabular rated cases.

At the other extreme are cases where the tabular rates are ignored and the premium is ascertained from the past experience of the risk alone. These may be described as truly experience rated cases. True experience rating is only used in very large cases, with premiums certainly over £100,000, probably over £1m.

In the middle are many cases where the underwriter after selecting a tabular rate adjusts it upwards or downwards depending on the past experience. In this paper such cases are are described as "partially" experience rated.

In practice, even in tabular rated cases the underwriter may have some discretion as to the selection of the appropriate rate within a band given in the rate book. In making his choice he may well be influenced by the past experience. Thus he may implicitly be partially experience rating, although he may not recognise it as such. The distiniction between tabular rating and partial experience rating is therefore somewhat blurred.

Usually the last five years' experience is taken into account. Where a risk with a premium of more than £1000 is being rebroked the holding office provides the experience for the competing offices using a standard form agreed between offices for the purpose. A copy of this form is attached as appendix 2.

4.5 Rating Revisions: the Classical Approach

How does the underwriter feed back the claims experience into his rate-making decisions? Under the classical theory, when the Tariff was in its heyday, the procedure was to continually adjust the rates using a three-tiered approach to losses.

"Small" losses would be borne by the individual case through (partial) experience rating. With large or medium policies, there would be no problem, but a small policy might well not pay for itself. Such a policy might well have to be be declined at the next renewal date (see section 3.4).

"Medium" sized losses would not be borne case by case, but funded out of the total class premium. That is, each trade or industry, considered on its own, should be self-supporting. If the experience for a given trade were in debt, then the rates should be increased, say by 5 or 10%, or some appropriate margin.

"Large" losses (or, at least the excess of large over medium) would be borne by the whole of the portfolio. Thus, the commercial fire business in toto should be profitable, although given trades might not be, on account of exceptional large losses during the period in question. A deficiency in the portfolio from large losses would need to be corrected by an overall increase in the rates.

The resulting adjustments to Tariff rates were known as SOPAs (Schedule Of Percentage Adjustments), reflecting the way the FOC communicated the adjustments to member offices.

4.6 Rating Revisions: the Modern Statistical Approach

In an office with a modern data system, the underwriter may take a more detailed and objective approach. Every risk will be classified, and the results collated over the years, until at least a 10 year run of exposures, premiums and claims is available. From these figures, such information as the claims incidence per 100 policies and the average size of claims can be obtained together with their trend over the years. In addition, a statistically based set of burning rates can be derived, giving in effect the pure risk premium for each class of business in the fire portfolio.

A number of fixed markers are thus established for the underwriter, giving him a firm base. His next step will be to predict the future mix of business which the company may expect to obtain. The pure risk rates can then be converted to a range, in order to cover the business mix expected within each class. It is at this stage that the factors making for heterogeneity, such as physical construction, management and housekeeping, fire protection systems, etc. can be brought into account together with a loading to pay for catastrophe losses. An allowance would also be made for inflation to cover the delay between underwriting the risk and settling the claims.

The final result of the process is a rating scale for each trade, in many ways akin to the earlier Tariff version. The differences are:

That trends in the statistics can quickly be recognised and action taken at the next rating review.

- That there is more evidence available for analysing the effect, say, of a change in the mix of business, or of a given underwriting factor.

- There is no need to wait scrupulously on other offices of the FOC to agree revised Tariff rates, and hence particular opportunities in the market can be more quickly taken up.

- The rating base is more accurately set, in terms of its structure as well as its overall level.

4.7 Expenses and Commission

In the "classical" approach expenses and commission would be covered by working to a target claims ratio rather than a target underwriting result. Thus expenses and commission were implicitly assumed to be a fixed proportion of the office premium.

In the "modern statistical" approach expenses are treated explicitly. They are analysed into:

A. Policy handling expenses. These may be further sub-divided into

   (i) Expenses incurred in getting policies on to the books including commission and certain sales expenses.

   (ii) Other sales expenses which are incurred irrespective of whether the policy gets on to the books, including the cost of sending out renewals, quoting for new business, conducting surveys.

   (iii) Maintenance expenditure while the policy is on the books including the cost of endorsements etc.

B. Claim handling expenses

C. Overheads

A view has to be taken of the way in which expenses, especially expenses which cannot be directly related to policies on the books, shall be recovered. Some of these decisions will be the responsibility of the fire underwriter and he will make his decision depending on whether he wants to encourage or discourage particular sections of the account or policies with large or small sums insured etc. Some decisions will be outwith his control and taken by the senior management of the office depending on their strategic view of the fire account within the business of the office as a whole.

Commission is invariably a percentage of the office premium and presents no difficultly.

5. AN ACTUARIAL PERSPECTIVE

Having looked at the underwriter's thinking, and set out the main principles and features involved in rating a risk, we are in a position to consider fire insurance from the actuary's point of view. The discussion will concentrate on tabular rating structures and experience rating, before going on briefly to credibility theory and Continental premium theory.

5.1 Tabular Rates and Rating Factors

Typically, tabular rates have been developed by looking at burning costs by trade group and for those where experience was bad subjective adjustments made. Thus the complexity of rating structure has been built up over the years as more and more attempts were made to isolate the "good" risks. The problem of identifying "good" risks will be returned to in the sections on experience rating (section 5.2 et seq.)

Underwriters do not generally take into account the interaction between rating factors, implicitly assuming them to be independent. Testing the accuracy of this assumption could be a fruitful area for actuarial activity. There are three main questions to be answered:

A. Are any of the rating factors redundant as they do not add anything to the assessment of the risk?

B. Can any of the rating factors be split further into a greater number of levels?

C. Do the rating structures correctly reflect the inter-dependency of the rating factors? As an extreme example, it would be expected that the premium for a dynamite factory containing spark generating machinery would be very much higher than the sum of the premiums for a dynamite factory with no sparking machinery and a similar factory in which sparks were generated but materials were non-inflammable.

Analysis is however far from being straightforward. For example only factors which can be quantified are amenable to analysis. Purely subjective adjustments cannot be measured so it is impossible to say where they are right or wrong. The data collected must be sufficient to make the analysis significant at the level of detail being examined. Because of the wide ranging nature of the risks insured many offices will not have sufficient data themselves. Even where exposure is significant often data are not captured in a form which is amenable to analysis. One solution is the collection of market statistics and a start has already been made in this direction (see section 9).

The logic behind the use of EML as a rating factor can be illustrated by a simplistic example. Consider two otherwise identical risks A and B except that A has an EML of 50% of sum insured and B has an EML of 100% of sum insured. The sum insured for both risks is £1m. In the event of a severe fire, then in theory the maximum loss on A is limited to £0.5m, while the same loss on B would be in the range £0.5m to £1m. Thus, since a severe loss claim on B is going to be considerably more costly than for the same loss on A, with all other things being equal a higher premium should be charged for B than A.

On the other hand, using the relationship of EML to sum insured implies charging less for a policy covering a number of separate buildings than the sum of the charges for separate policies each covering one building. For example, a single policy covering two identical buildings like B in the previous paragraph would have EML = 50% of sum insured and would attract a smaller premium than two policies each covering a single B-type building and each with EML = 100% of sum insured. A possible justification for such a procedure might be that by doing more business the office has reduced the variance in the expected outcome and hence the risk it is running in carrying on its business as an insurer. However, the whole basis of insurance is the reduction of variance through the pooling of risks. It could be argued that the saving in premium available because of this reduction in variance should be shared between all policyholders transacting business with the office rather than just those who have large policies where a total loss is unlikely. It is also difficult to see how the EML factor could be adjusted where the variance is being reduced through reinsurance/coinsurance etc. arrangements.

One avenue which might be worth exploring would be to rate each separate building according to the absolute value of the building's EML rather than its relationship to the sum insured. Thus the premium would be x% of the building's S.I. plus y% of its EML. In view of the comments in section 3.6, perhaps the value of y should increase with an increase in the absolute value of the EML.

5.2 Partial Experience Rating

Partial experience rating was defined in section 4.4 from the actuarial viewpoint the partial experience rating of fire risks is fraught with danger. Consider the following two theoretical groups of risks:

A. Risks whose experience during the period examined is genuinely better or worse than the average.

B. Risks which are normal or average but whose experience during the period examined deviates from the average due to random fluctuations.

Partial experience rating should affect the premium of only the first of these groups but it is difficult to see how the methods of partial experience rating carried out in practice can distinguish between the two groups.

The problem arises because of the very skew distribution of claims by size (see section 8.4). This results in the modal experience being significantly better than the mean experience. As a result most experiences which in reality are "average" are classified as "good" and given a discount from the tabular rates. A few experiences will be classified as "bad" but it is unlikely that the very large loading indicated by the experience could be carried. The net effect of partial experience rating on a large number of average cases is thus that rather less than the total average premium is collected and losses ensue (at least compared with the profit target underlying the tabular rates).

The standard claims experience reporting form (Appendix 2) attempts to get over this problem by giving separate information on large losses during the five years being examined. However the information is very sketchy and its use would be hampered by the following shortcomings:

a. There is no indication of changes over the period in the exposure whether by amount or risk mix or cover.

b. Since the claims are not split by peril it is difficult to relate the large claims to the small ones.

c. Although the total claim cost is split between paid and outstanding the cost of the large claims is not so split.

Even if perfect information were available on the past experience including large losses (as it would be for the holding office) the use of such information would require a view of the underlying claims size distribution. A useful distribution is not readily available for at least the following reasons:

i) The claims size distribution for any given portfolio will depend on the distribution of sums insured exposed. This will vary considerably between insurers and for a given insurer between accounts. Furthermore the sum insured distribution of the cases which are experience rated will be different from the distribution for a portfolio as a whole. And again, the sum insured of the case being examined, or the distribution of sums insured if the case is a collection of risks, will be different from the sum insured distribution of all cases which are experience rated. For example, if the case sum insured were £1m it would be impossible for it to have a claim exceeding £1m yet a typical claims size distribution for fire could show 10% of total claims cost in the "over £1m" band.

ii) The peril mix of the case being examined would be different from the mix in the portfolio from which the distribution was obtained.

It is difficult to see how even pooled market statistics will be much help in this area.

5.3 True Experience Rating

True experience rating (see section 4.4) is subject to the same difficulties as partial experience rating. Premiums will tend to be based on the modal experience rather than the mean as it would not be practical to charge a very large premium for the renewal of cases which have suffered a disaster. The fact that the premium is very large, possibly over £1m, does not necessarily make the case more amenable to true experience rating as the high premium may merely be reflecting a high risk, ie one large risk. On the other hand if the large premium reflects a high claim frequency together with a lower sum at risk (for example a collection of smaller independent risks) true experience rating could be appropriate as the variance of the expected losses may be brought within bounds.

There could be a case for using the EML here: true experience rating could be applied only when the EML is less than a certain percentage of the sum insured, the percentage depending on the sum insured and perhaps also on the corresponding tabular rate for the risk (if there is one).

5.4 Effect of Experience Rating on Tabular Rates

To some extent all business is experience rated because the tabular rates themselves are derived from past experience. Tabular rates may therefore suffer from the same defects mentioned above for experience rating for, unless the exposure was very large at the level at which the rates were compiled, there is a danger that the rates will be set according to the modal experience. Despite this, fire insurance has been run at a profit for very many years using a very detailed rating structure so presumably the modal rate has been sufficiently loaded for "contingencies". The danger with this approach is that in soft market conditions there may be a temptation to view the contingency loading as dispensable when in reality part of it is necessary to bridge the gap between the mode and the mean.

When tabular rates are compiled the experience used usually includes partially experience rated cases and true experience rated cases as well as tabular rated cases. This means that it is impossible to separate the effects of the tabular rates and experience rating. For example, a poor experience will lead to increases in the tabular rates when possibly they were correct: it was excessive discounting through experience rating which caused the problem. There are instances where the tabular rate for a particular trade is derived from an experience very little of which is tabular rated. This is clearly anomalous. In theory only tabular rated cases should be included in the analysis.

One by-product of using the combined experience to set tabular rates is that poor experience of true and partially experience rated cases feeds its way through into the tabular rates and thus eventually puts up the rates for everyone except the true experience rated cases.

5.5 Rating Large Excesses

Some idea of the claims distribution by size is needed before discounts for large excesses can be quoted. However, it is not sufficient to know the relative numbers of claims expected in each sizeband for the reasons discussed in (i) and (ii) of section 5.2. The analysis has to incorporate the distribution of the sums insured of the risks to which the claims relate.

5.6 Credibility Theory

Experience rating is related to credibility theory. There the premium is expressed by the following formula

$$P = Z.E + (1-Z).T$$

where P is the premium to be charged,
E is the premium indicated by the experience,
T is the tabular premium,
and Z is the credibility factor.

Z is assigned a value between 0 and 1 depending on how statistically significant the experience is.

Assessing the value of Z is clearly crucial to this exercise. In practice rules of thumb are often adopted which are convenient but which do not have a rigorous statistical background.

5.7 Premium Theory

Continental academic actuaries have developed an extensive premium theory. If the amount of claims per policy per year is a random variable X then the premium P is fixed as

$$P = E(X) + G(X)$$

where E(X) is the mean of X
and G(X) is a function depending on the distribution of X.

Many premium principles have been formulated which derive the function G(X). These include the Swiss Premium Principle, the Esscher Principle, the Variance Principle and several others.

According to the Variance Principle

$$P = E(X) + K.VAR(X)$$

where VAR(X) is the variance of X
and K is a constant or parameter that can be fixed in relation to the class of business.

Thus the idea of the variance principle is to make the contingency loading proportional to the variance of the total claim size per policy. In theory the dimension of the variance term is wrong and this can produce some unsatisfactory results. Nevertheless the variance principle has some intuitive appeal because fire insurance shows greater variation both in claims size and claims frequency than many other kinds of insurance. It is therefore desirable to have higher contingency loadings for fire insurance.

5.8 Investment Income

The actuary, with his knowledge of investment principles and discounting will be inclined to favour the concept of "insurance profit" (ie. including investment returns) over that of "underwriting profit". However, in his discussions with underwriters he may find communications work better if he thinks in terms of a target underwriting profit set by subtracting investment income from the actuary's target insurance profit.

In order to assess the investment income it is necessary to examine the pattern of claim payments from occurrence to settlement, patterns of delays in receipt of premium and the effect of reinsurance on both premium and claim patterns. The delay from inception to claim occurrence coupled with settlement delays can easily reduce the cost of claims by 10-15% viewed from the point of inception of the policy. The delay in the receipt of premiums is often considered to be 3 months but in practice may be much longer and needs to be investigated. This delay reduces the value of the premium and the associated commission by around 3-5%.

If reinsurance is insignificant the net effect may be worth perhaps 5% of written premium. If reinsurance is significant detailed calculations have to be done allowing for the timing and amounts of reinsurance premiums and claims. Where the reinsurance is inwards delays in receipt of premiums can be very significant leading to greatly reduced, even negative investment income. In such a case not taking an explicit allowance for investment income could be dangerous.

6. COMPUTERISED UNDERWRITING SYSTEMS

6.1 Background

As in other classes of insurance computer systems are extensively used to aid the administraton of fire policies. Typically these were batch systems although increasingly they are being converted to on-line systems or even to real-time on-line systems.

A number of companies are now producing computerised quotation systems. This is an interesting development because few such systems exist for commerical insurances, where judgement plays an important part in premium rating. Quotation systems have been more common in motor and domestic insurance, where the premium can be calculated automatically from a set of rating factors.

6.2 Expert Systems

Recently, work has gone further, to investigate the application of expert systems for fire quotations. This represents a new departure for commercial fire underwriting, and indeed for the insurance and financial sector as a whole. Although in the last 10 years there have been a number of well-documented expert systems for scientific, medical and engineering applications, penetration in the financial world has, as yet, been slow.

But the picture is changing - especially through the Japanese 5th Generation Initiative, and the UK response in the form of the Alvey Programme. Under the umbrella of the latter, pioneering work for the insurance industry has been done by a consortium of companies known as the 'Aries Club'. This club, aided by expert underwriters from three major companies, has developed a successful prototype system for commercial fire use.

The prototype itself is limited to assessments for one particular industry - clothing - but is in such a form that it could soon be developed to cover risks in other industry groupings as well. The benefits to be obtained from such a system are fourfold:

a) Making head office expertise more widely available in the branches, and reducing the number of cases referred back to head office.

b) Helping to standardise underwriting practice and criteria throughout the company.

c) Improving the general quality of underwriting decisions in the company, and their responsiveness to change.

d) Assisting new entrants to learn the underwriting profession.

6.3 The Aries Expert System

The system is straightforward, and mirrors many of the reasoning processes of the underwriters concerned. At the top level, the domain is broken down into a number of major factors influencing the underwriting decision:

Physical construction of the building
Heating systems
Trade processes
Management and housekeeping
Fire protection systems
Location

Each major factor is then further analysed according to its characteristics. For example under 'management and housekeeping', the aspects are trade waste and its disposal, smoking regulations, discipline of workforce, level of security and so on. When a particular risk comes up for analysis, the underwriter will be prompted by the system for information on these points. His answers will be given from his perusal of the surveyor's report, which he will in effect interpret for the machine. Once the answers have been given, the system will combine them according to its reasoning pattern to give an overall result for the risk. This result will be in terms of a qualitative scale:

Accept risk with discount	Accept at normal rates	Accept with loading	Consider rejection	Reject outright

In the event of an acceptance, the system will do further calculations in order to recommend a rate of discount or of loading, as appropriate. But the system does not make any contribution to the setting of a normal rate for a given industry - it assumes that a standard rate book is available for this purpose.

An important feature of the Aries system, as indeed of expert systems in general, is its explanatory facility. Thus, if the system recommends 'Reject risk', the underwriter can enquire for what reason. The reply will first be given at the top level, to identify any major factors in the decision, eg:

'Reject risk' - on 'management & housekeeping grounds'.

Following this, the question can be pursued in more detail:

'Management and housekeeping reject' - because 'unregulated smoking by employees'.

The underwriter now knows that here the first consideration will be to persuade the employer to introduce a ban on smoking in the factory, or at least a strict control. In such a way, the expert system can provide very practical advice during a session.

Although the Aries Club's prototype is not yet a fully viable commercial system for fire underwriting, it does illustrate in a graphic way the potential for expert systems in this area. The system has been made available in a form suitable for running on an IBM PC or compatible machine, and is being put to further testing and refinement by member companies of Aries. Such methods are still in their early days for insurance purposes, but there is little doubt that in course of time they will come to play a significant role in the industry.

7. REINSURANCE

7.1 Background

Commercial fire insurance is concerned with the insurance of buildings and stock which can have very high values but with low likelihood of claim of a significant size. However, where a major loss does occur the claim can run into many millions of pounds for the largest buildings. Such risks are beyond the scope of one office to retain entirely for itself. There is also the need to be protected from catastrophes, one event giving rise to a number of claims.

7.2 Individual Risks

Whilst facultative reinsurance can be arranged for very special risks, it is impractical to do this on day to day business. Companies writing commercial fire business will have protection under a reinsurance treaty. In the past, this has commonly been of the proportional type, surplus and quota share. However, several years of poor results have recently resulted in significant contraction of the proportional market and greater use is now being made of non-proportional reinsurance which had previously been used only by the largest insurers for individual risk protection.

When a company's reinsurance programme is insufficient to fully write a risk then the risk will be co-insured with other direct insurers until sufficient capacity is available to absorb the risk.

7.3 Level of Retentions

The setting of retentions is often based on old and trusted rules of thumb, relating maximum retentions to the size of the retained premium income. Reinsurers have to be consulted in setting the level.

Individual retentions are determined by the EMLs of the particular risks. Some allowance needs to be made for incorrectly calculated EMLs.

Although companies generally relate retentions to premium income they appear to differ in which premium income they choose. Some will use the income of the fire account while others may use the UK general branch premium income. It would be possible for a large composite to even go as far as using the total premium income of the whole group. The size of retention will vary considerably according to which view is taken.

A company may employ several different retentions, the least hazardous risks having the highest and the most hazardous the least. This is, however, contrary to risk theory.

The level of retention is clearly an area where actuarial expertise could well be employed, using risk theory.

An example may be helpful:-

Insurance company ABC has a scale of five limits from £250,000 to £500,000. Its own capacity is supplemented by a 10 line surplus treaty (ie the company can place on its treaty up to ten times as much as it retains itself).

For a certain risk its limit is £500,000. This risk has a sum insured of £5m, but the EML has been calculated at £3M, (60% of sum insured). Then five lines of the treaty capacity are used and the retained and reinsured risk are, therefore, split:-

		£m	%
Company ABC	EML	0.5	16.67
Treaty R/I	EML	2.5	83.33
	EML	3.0	100.00

The premiums and any claims arising are then split in the same proportions.

Suppose a fire occurs and total loss results ie the EML of 60% of the sum insured is proved to have been incorrect and EML failure is said to have occurred.

The claim is shared out:-

	£m	%
Company ABC	0.833	16.67
Treaty R/I	4.167	83.33
	5.000	100.00

Then Company ABC finds that instead of a maximum claim of £500,000 it has received a claim for £833,000.

In practice, an office's reinsurance protections may be more complicated by having more than one surplus treaty and by the way in which the office uses them. For instance, extending the above example, company ABC also has a 5 line second surplus treaty. For the risk considered the company may decide it wishes to retain only 50% of its limit of £500,000. The risk will then be split in the following way:-

	£m
Retention of Company ABC	0.25
First Treaty R/I (10 lines)	2.50
Second Treaty R/I	0.25
	3.00

Thus, the full ten lines of the first treaty have been used and one line of the second treaty. Depending on the treaty contract wording, the ten lines of the first surplus treaty need not be used in full before the second treaty is brought into use. In this example it is assumed that the first treaty is fully used before the second treaty, and reinsurance terms may well encourage this with a higher commission rate on the first surplus treaty than on the second surplus treaty. Alternatively it may be that there are two surplus treaties which are used in parallel rather than one sitting above the other as in the above example. Where an office manipulates the ceding of business to different treaties, perhaps ceding all doubtful business to one treaty and all good quality business to the other treaty, one set of reinsurers may feel somewhat aggrieved. In the long term, the office will pay the price of any such unfair play by the terms, usually commission, on which it gets its reinsurance placed.

7.4 Catastrophe Protection

Catastrophe protection is required to protect against a number of claims arising from one event such as storm damage and it is arranged on a non proportional basis to protect the net retained account.

There are various ways in which such protection may be arranged, such as:-

a) Cost of claims arising from a single event, and may be allowed to accumulate over a period of 72 hours say, in excess of a trigger point which itself needs to be above the maximum net retention.

b) Stop loss type covers are very helpful in protecting an account against an accumulation of many claims arising from say a lengthy period of severe weather. They are, however, difficult to obtain unless good historical data is available to reinsurers and even so only limited cover may be available.

Determining the amount of catastrophe cover required is educated guesswork but would be based on a cataclysmic event such as the damage occurring if the Thames Barrier failed to work and London was flooded. It is necessary to have available geographical data on exposure.

The catastrophe protection cover would probably also protect the household account.

7.5 Accounting for Reinsurance

Proportional treaty reinsurance is usually accounted for in the same way as the direct commercial fire account, except that the treaty terms may not fully reflect the office's own accounts. In particular, unearned premiums may be at 35% of written premiums for the 12 months period and outstanding claims at 90% of the office's own reserves. The former adjustment assume business evenly written over the year and incorporates a realistic deduction for commission, at 30%. The latter adjustment is because offices' own reserves on fire business are usually in aggregate in excess of the ultimate settlement, even though there is no specific IBNR provision.

Rather than running the year's business off to final settlement, portfolio transfers are usually made into the following year's reinsurance, the transfers taking in both unearned premiums and outstanding claims. This makes dealing with reinsurers differing shares of the treaty from one year to the next rather simpler.

An example may clarify the differences:-

An office's fire account has the following results in respect of its proportional reinsured business on its own accounting basis:-

	1984	1985
	£'000	£'000
Written Premiums	10,000	11,000
Unearned premium B/forward	3,525	3,710
Unearned premium C/forward	3,710	4,092
	9,815	10,618
Claims payments	5,300	5,900
Outstanding claims B/forward	4,800	5,400
Outstanding claims C/forward	5,400	6,280
Incurred claims	5,900	6,780
Commission @ 30%	3,000	3,300
U/W Profit	915	538

Earned premiums are based on the twenty-fourths method, with 20% initial deduction.

In presenting results to reinsurers with unearned premiums at 35%, and outstanding claims at 90% of the office's own reserves, the results become:-

	1984	1985
	£'000	£'000
Written Premiums	10,000	11,000
Unearned premium B/forward	3,325	3,500
Unearned premium C/forward	3,500	3,850
	9,825	10,650
Claim payments	5,300	5,900
Outstanding claims B/forward	4,320	4,860
Outstanding claims C/forward	4,860	5,652
Incurred claims	5,840	6,692
Commission @ 30%	3,000	3,300
U/W Profit (before expenses)	985	658

Portfolio transfer from 1984 into 1985 = 3,500 + 4,860 = 8,360

Portfolio transfer from 1985 into 1986 = 3,850 + 5,652 = 9,502

Individual reinsurers would be sent an account reflecting their share of the treaty for the particular year. By this means allowance is simply made if a reinsurer's share changes from one year to the next.

7.6 Security of Reinsurance

There is no point in reinsuring if the reinsurer is not able to meet the claims when they occur. It is fundamentally important to have a system of scrutinising reinsurers for financial soundness. In the past, it was common under proportional treaties for the cedant to retain part of the reinsured reserves and pay to the reinsurers rates of interest which by modern day standards were derisory. Reinsurers are most reluctant to accept such arrangements any more.

The security of captive reinsurers has been put in doubt by the collapse of one such company where the captive's parent refused to bail out the company despite the parent's obvious financial ability to do so. This situation could also apply to any subsidiary of a parent. Thus you cannot necessarily look at a parent's accounts when determing the security of a subsidiary. Obtaining the soundest level of security may involve paying more for reinsurance protection, either in lower commission rates on proportional reinsurance or higher premiums on non-proportional reinsurance.

7.7 Co-insurance

Mention has been made in paragraph 7.2 above of the need for co-insurance on very large risks. Premiums and claims are shared out proportionately with each co-insurer being a direct insurer. Then if one of the co-insurers becomes insolvent, the other coinsurers are still only responsible for their original share on any claims that may arise during that period of insurance.

The lead office receives an overriding commission from the other co-insurers for the expenses it incurs in carrying out surveys, setting up the policy etc.

7.8 Co-operative Agreement

Under the FOC rules a risk placed on a coinsurance basis had to be placed at least 60% with FOC offices (the 60/40 rule). Within this rule the broker had discretion as to whom he invited to have a share of the risk. Following the demise of the FOC some of the larger offices agreed among themselves that they would individually write all risks 100% and then reinsure between themselves. From those large offices' point of view this appears, at first sight, to be a good way of maximising their market share; however it has the obvious disadvantage of leaving them very heavily exposed in the (unlikely) event of one of their reinsurers not being able to meet their liabilities.

Understandably the brokers were not happy about such arrangements as they would then be unable to place business with their "friends". The largest companies would benefit at the cost of the smaller ones. Many did not believe that the system would ever work in practice; however, it did work at least to a limited extent. Although this cooperative agreement is now falling into disuse, it is probably true to say that it did have the effect of stabilising the market in the months following the demise of the FOC.

8. CLAIMS

8.1 Basis of Settlement

For a fire claim, the amount payable will depend upon the basis of cover (see section 2.2), and will be limited by the sum insured. Nowadays, the 'average' rule is nearly always applied.

If there is more than one office involved, costs are shared, essentially in proportion to sums insured at risk. Detailed rules deal with cases where the cover provided by the various offices is not identical, for example as to excess and whether average applies.

In practice, because reinstatement will take some time during which the policyholder may not be able to carry on his business, the office will usually negotiate a cash settlement so that the insured can buy another building without delay (and minimise the Consequential Loss). This is especially likely to happen if the reinstatement cost exceeds the market value to any great extent.

8.2 Claims Handling Procedures

The office will usually employ specialist loss adjusters to advise on the claim. Loss adjusters are members of the Chartered Institute of Loss Adjusters, entry to which is by examination together with an experience qualification.

The loss adjuster is nominally independent of the insurer and tries for a settlement that is fair to both sides, but as his fee is paid by the office he cannot really be independent. Because of this some claimants employ specialist loss assessors to negotiate on their behalf. The loss assessor's fee is paid by the claimant and is not recoverable under the insurance.

The loss adjuster is briefed by the office on details of cover and any warranties. From his examination of the aftermath of the fire he will give an opinion as to whether the claim is valid. As investigations and negotiations proceed he will also advise the office on the appropriate reserve.

To help him advise on liability and quantum, the loss adjuster may call on other professionals. If there is any suspicion of arson (perhaps evidence of accelerants) he will bring in forensic experts. Consulting engineers will advise on the extent to which property is damaged and whether it can be repaired.

The loss adjuster will also take such steps as are necessary to minimise losses. For example he will arrange for buildings to be shored up, machines to be greased to minimise water damage, and for the disposal of salvage. There are specialist firms who deal in dehydration, rehabilitation of furnishings affected by smoke, etc, and the loss adjuster will use them as necessary.

8.3 Claims Reserving

A useful starting point will be the estimate made by the loss adjuster. He will normally advise the possible loss - perhaps not the maximum possible but a pessimistic view and more than the "expected" cost in a probabilistic sense. If the values used by the loss adjuster are used without adjustment, the office's total reserves, but not necessarily each individual reserve, will usually be more than sufficient. Typical reasons for this include:-

A. Settlement may be for market value (plus a sweetner, perhaps), when the initial estimate was based on the reinstatement cost.

B. Recoveries may be possible from third parties.

C. The claim may be repudiated.

Some offices, because of the tendency to over-reserve, may only use these estimates as a base. They may use some statistical methods for estimating claims. These could take the form of a member of the triangulation family, or a method based on the average cost per claim and claim frequency, or a mixture of the two. These methods may be combined with manual estimates of large claims using the loss assessor's report.

8.4 Claim Size Distribution

It has been suggested that the lognormal distribtion is suitable to represent the distribution of fire claims by size.

This distribution has two parameters - μ and σ. The probability density function for the lognormal is:

$$f(x) = \frac{\exp\left[-\frac{1}{2}\cdot\frac{(\ln x-\mu)^2}{\sigma^2}\right]}{x\sigma\sqrt{2\pi}}$$

and the moments of the distribution are given by:

$$E[X^n] = \exp\left[n\mu + \tfrac{1}{2}n^2\sigma^2\right]$$

The lognormal distribution was fitted by the method of moments to typical claim size data. A close inspection of this particular empirical distribution based on four years experience of a particular office shows that the fit is not good. A better fit could be obtained in this case by regarding the observed distribution as a mixture of two distributions.

Large claims are a feature of commercial fire business. The ABI produces monthly figures for the number of large fires. The definition of a large fire is updated regularly using the RPI index. An examination of the data suggests that there is no strong evidence of seasonality. There appears to be a trend towards fewer large fires.

9. STATISTICS

9.1 Data collection and analysis

As mentioned in section 3.2, there used to be a Tariff in the UK for commercial fire insurance. Major Tariff offices supplied computer based information to the FOC, the body responsible for the administration of the tariff, and from this input, statistics were produced which enabled the Tariff rates to be reviewed.

For many years, the underwriting experience was favourable and under these conditions, there was little incentive for offices, whether Tariff or not, to create an improved statistical system or to carry out any other statistical analyses. During the 1960's the underwiting experience became increasingly adverse and offices did not have the systems or expertise to respond. Consultants were brought in to advise the FOC, but again the paucity of offices' systems did not allow the consultants' recommendations to be fully implemented. Despite some improvements since then, the data bases available within offices at the present time in respect of commercial fire insurance are still probably some 10 to 15 years behind those for major personal lines such as motor business.

The FOC Tariff statistics (together with the ABI market scheme) are discussed in section 9.2, but in principle the Tariff exercise revolved around loss ratios - ie. the ratios of claims to premiums. Most offices' computer systems were geared to provide information of this kind, but few could go any further. In particular, for example, few offices were in a position to produce reliable information on sums insured which - especially in the absence of a Tariff - is an appropriate measure of exposure to risk for this class of business.

However, if accurate burning cost statistics are to be produced, whether on a company or market basis, it is essential that they be calculated from accurate sums insured. The current inability of much of the market to provide this information is the most serious deficiency at present to statistical underwriting.

It is not intended to discuss here all the problems associated with the provision of accurate sums insured information, but it must be acknowledged that these are not trivial. Amongst the matters which would need consideration are:-

- Retrospective adjustments to the sums insured, especially in respect of stock;

- mid-term changes in sums insured or trade, especially if these do not affect the premium;

- varying methods of inflation provision.

All of these difficulties would be compounded if they affected only certain of the trade classification lines covered on a multi-line policy.

Beyond this fundamental point, there are other, though less vital, points which need to be considered. Amongst these is the need to record and analyse other factors which could influence either the risk or the nature of the claims which have to be met - for example: levels of excess or deductibles, the age and standard of construction of the property, fire protection equipment available (particularly sprinkler systems), locality, security of premises and so on. In addition there are more basic points such as type of policy and nature of cover (eg indemnity or reinstatement cover, traditional full value policy or first loss or layered cover). For consequential loss insurances, the maximum indemnity period is also important. The treatment of conglomerate or experience rated risks also needs to be considered.

Another major consideration from a statistical point of view should be the treatment of 'perils'. It has been estimated that up to 30% of material damage claim payments are not in respect of fire losses, but are due to additional sections on the policy covering perils such as storm, flood, explosion etc. Despite this, many offices do not record details of the perils covered in a way which would allow premium rates or burning costs to be examined. The most vital need is therefore to record details of the perils covered by the policy and the sums insured associated with each. It could be argued that peril claims should be analysed by both trade and locality: for example, some trade processes may be more explosion prone whilst some localities may be more liable to flooding. This is undoubtedly true, but given the current state of the art, it would be a major development to obtain any information at all on individual perils, let alone by other factors, however desirable this may be in theory.

Although the title of this section referred to both data collection and analysis, the current paucity of worthwhile data means that any meaningful analysis remains, for many offices, something of a pipe dream. The most important analysis for use in statistical underwriting would be the calculation of burning costs by trade, but in the absence of exposure data this is currently a target rather than an achievement.

Even if accurate data were available, many statistical problems would remain to be solved for an analysis to be of maximum benefit. How are large claims to be handled, given that a single large incident could distort the experience of the whole portfolio, let alone that of a particular trade category? Even without large claims, some trade categories will contain only small volumes of data, so what credence can be attached to the results?

Without exposure data, claims can be analysed to provide information on the relative importance of perils, the distribution of claims by size, or the payment pattern over time. Whilst useful to the claims manager, these would be of less interest to the underwriter who, regrettably, must often still wait for his computer system to be brought into the 1980's.

9.2 Market Statistics

The FOC - until its demise in 1985 - collected statistics from certain of its member companies which, after aggregation, were used to review Tariff rates. In the recent past, this exercise had been computer based with offices supplying input details of individual policy transactions and individual claims on magnetic tapes. In practice, many FOC offices were extremely small and thus detailed data input was provided by only about 8 offices which, being the larger ones, held the lion's share of the business.

The claims input was used to maintain a claims master file of individual records and this could be analysed in whatever way was required. The policy input records were on a totally different basis and consisted only of policy transactions by the office since the previous submission was made. This would comprise details of new business, renewals, lapses, cancellations or changes to existing business (eg. in sum insured or classification). Transaction records (each of which showed its effective start and end date) were treated in complete independence of each other - that is, no serious attempt was made to link together different transactions from the same policy. The input records were grouped only by the period to which they applied and, by summing over the required period, the appropriate totals could be found.

The FOC output, in theory, gave both loss ratios and burning costs; the validity of the loss ratios obviously depended upon the observance of the Tariff and, given that this was generally so, the figures produced by the FOC were acceptable. The burning cost results, however, were acknowledged to be inadequate and this stemmed from the policy transaction method of supplying input. It will be clear that for records other than renewals or new business, records on the transaction file must show the incremental or decremental portion of the premium and sum insured. In general, this requirement presented no difficulty for premiums. Offices knew the premiums which they were returning or the additional premiums which they require, although splitting this between classifications on a multi-class policy did occasionally present difficulties. The problems were far greater for sum insured, and many offices were unable to show the proportionate reduced or additional sum insured which was equivalent to the returned or additional premium. For this reason, the FOC burning costs statistics were not regarded as being particularly reliable.

By about 1980, many offices correctly believed that the days of the commercial fire Tariff were numbered and they foresaw the need to have a central statistics scheme for this class of business which did not primarily depend upon a common system of rating. As a result, and after some exploratory research and soundings, the Market Fire Statistics Scheme was established in 1982 initially under the auspices of the British Insurance Association but subsequently under the Association of British Insurers after the formation of that body in July 1985. The exercise runs on a "voluntary group" basis and at present has 24 member offices, between them having approximately 80% of the company share of this market.

The primary aim of the Market Fire Statistics Scheme is to produce burning cost statistics by trade classifications on a market wide basis which will assist in the underwriting of commercial and industrial fire risks. Despite the known problems in obtaining data on sums insured, it was agreed that the statistics produced by the market scheme should relate claims to sums insured rather than premiums. This was because, in the absence of a tariff, there will be no common premium for a given risk and the ratio of claims to premiums on a market basis would be of little use to individual offices in re-examining their own particular rating structure.

Having acknowledged the problem, the scheme is attempting to build on the experience of the FOC scheme both by allowing alternative forms of input and by collecting data which could allow more extensive analyses in future.

Whilst the transaction style approach outlined earlier is theoretically the most accurate and, as such, is acceptable input from those offices who can provide accurate data in this way, the scheme also allows for policy data to be provided by taking quarterly censuses of the entire in-force file. Although by its very nature this can never be totally accurate, it is believed that it will be substantially better than receiving incorrect transaction records. Whilst the purpose of the scheme is the production of burning cost figures, premium data are also collected and will allow for the calculation of loss ratios if required.

The input files also allow for the provision of other data. In particular, it is hoped that it will be possible to make a more detailed and accurate analysis than in the past of special perils (eg storm, flood, aircraft damage). Information is also being collected on features such as size of deductible and type of policy and cover. The scheme operates in two distinct parts - one for material damage and one for consequential loss insurances. In addition to the factors previously mentioned, the latter analysis also provides for examination of policies by period of indemnity and claims by actual period of interruption.

9.3 Availability of Statistics for General Research

It must regrettably be said that very few statistics on commercial fire business are available for general research use. No doubt many offices carry out analyses of their own figures but they are generally not prepared to make these publicly available.

In the UK statutory accounts, commercial fire insurance is included as part of the property class. Since this includes domestic property business as well as such other commercial lines as theft, engineering and so on, the figures available are far too broad for many purposes. In certain parts of these statutory returns, and in particular the section providing a claims run-off by year of origin, the main accounting classes have to be subdivided by risk group. The regulations do not define these risk groups and there is little conformity between offices in the groups which they choose to use. The majority of offices have a risk group called "fire" or something similar, but this may or may not include domestic business. The only way this can be determined is by seeing whether there is another risk group more likely to include domestic business and from a knowledge of the kind of business which that particular office writes.

For example, one office uses the five risk groups of fire, burglary, domestic, engineering and other. Under these conditions, it is highly likely that fire will be predominantly commercial fire. However, another office has four risk groups - fire, burglary, engineering and other; the fact that the "other" category is extremely small in size suggests that "fire" includes both domestic and commercial business. A third office simply uses two categories - domestic and other. Clearly the range of possibilities and options is enormous. Of some 26 major property offices considered, "fire" is likely to be predominantly commercial fire in only about half the cases.

Market statistics have already been referred to in section 8.2 but again these figures will only be available to those insurers who are members of the appropriate scheme. The FOC figures, with one exception referred to below, were confidential to the Committee itself and were used for the purpose of reviewing Tariff rates. The ABI scheme is equally confidential and has the intention of making results available only to offices according to the level of detail provided: that is, an office which does not provide information on a particular factor will not receive the output from any market analysis examining that factor.

The exception referred to above is that FOC statistics have been provided on a regular basis to the Comite Europeen des Assurances (CEA). CEA is a European insurance association and for many years, the Paris based secretariat of its Fire Committee has collected statistics of material damage and consequential loss business from member states. Participating countries include Austria, Belgium, Denmark, France, Germany, Italy, Spain, Sweden, Switzerland and the UK.

The statistics are based on the CEA fire classification which is a decimal based system with ten main categories each subdivided into ten sub-categories and so on. Special perils (such as storm, flood, explosion) are excluded from the figures. Non-sprinklered and sprinklered risks are collected separately, although most participating countries other than the UK cannot accurately separate these two types of risk.

As remarked, the present UK return is based on the Tariff statistics supplied by the main ex-FOC companies, with the FOC classifications being converted in the UK to CEA classes as accurately as possible before being forwarded.

The collected returns are published by the CEA at least 18 months after the year to which they relate and are circulated to participating countries. At time of writing (February 1987) the latest available figures relate to 1984. Although their subsequent distribution is the responsibility of each member state, it is inevitable that their circulation will be restricted.

The main declared use for the figures is to act as a basis for the rating of risks on a European basis. So far, Belgium is the only country to attempt a new rating system based on these European figures and it is too early to pronounce on the success of the exercise. The UK attitude to the figures is one of considerable scepticism.

Also on the international front, it may be worth referring to the World Fire Statistics Centre. The purpose of the Centre is the promotion, collection and use of international figures on fire damage. This in turn, it is hoped, will encourage fire prevention policies by Governments, insurers, commerce and industry and other interested bodies.

There is one other source of statistics which might be mentioned. In the UK, estimates of total fire damage are prepared and issued regularly by the ABI. These are based on the collection of information from offices and the press on large fires. The information obtained is then grossed up to give an estimate of all fire damage, regardless of size. The figures are intended to cover all material damage, whether insured or not, and cover both domestic and commercial properties. Although the precise figures will be subject to wide margins of error, it is hoped that a reasonable indication can be given of general trends.

APPENDIX 1: RATING FACTORS

A1.1 Introduction

The survey of offices' rating structures in the original paper showed a multitude of rating factors in use generally in the UK. No office specified all the factors in its underwriting guide. Nevertheless, underwriters would consider all the relevant ones in deciding on a rate and would expect them to be covered in the fire surveyor's report. In addition to these rating factors, in the larger cases rates would be adjusted to take into account the past experience of the risk (see section 4.4). Some offices also use the relationship of EML to sum insured as a rating factor (see section 4.3).

It is convenient to discuss the rating factors in three main groups:

* Inception Hazards - features of the risk likely to start fires.

* Contributory Hazards - features that would cause a fire once started to spread (or alternatively to be contained).

* Moral Risk - features of the management of the risk which could cause an increase in the inception or the contributory hazard.

However the allocation of the factors to these groups is to some extent arbitrary because there is considerable overlap between factors.

A1.2 Inception Hazard

Inception hazards can be likened to features which affect claim frequency.

Vicinity
What are the buildings round about like? How easily could fire bridge the gap?

Space Heating
Some methods (hot water radiators) are obviously safer than others (gas or electric fires). How easily can goods be moved too close to heaters (or heaters moved too close to goods)? How fire secure are watchmen's or storemen's cubbyholes, especially unofficial ones?

Lighting
This is not usually a problem with modern electric lighting.

Electric Cabling
Is the cabling adequate (not overloaded), switches adequately protected to contain sparks and insulation in good condition?

The Process
Knowledge of the trade carried on, from the proposal form is unlikely to give sufficient information on the actual processes carried on at the particular risk. The underwriter will want to know about hazardous procedures such as chemical reactions, drying processes, inflammable vapours (solvents), dust (many dusts are explosive when mixed with air) sparks (substances being ground will often contain stray metallic impurities). The underwriter will also want to know the throughput. The method and amount of transportation is important as are packaging procedures and methods of storage. Is apparatus left switched on when unattended, eg at night?

Hands
The underwriter will want to know the number of employees in the building (for this purpose each is deemed to have only one hand!) This gives him a measure of how congested the building is and of the chance of fire being started by human error.

Smoking
What rules are there on smoking?

Waste
Is the place kept clean and tidy and waste cleared away to a safe, secure area where it cannot be deliberately set on fire by arsonists?

A1.3 Contributory Hazard

Contributory hazards largely affect the claim amount.

Number of Storeys
As fire tends to spread upwards this is an important factor.

Construction
The type of supporting framework and the material used in it and in walls, floors, roofs and windows will determine the amount of damage caused by a fire. These factors are also important in determining how well a fire once started will be contained.

Age of the Building
This, together with a knowledge of historical building regulations, gives an indication of the standard of construction.

State of Repair
This will give an indication of the likelihood of a large loss through the building becoming unsafe. It may also give an indication of the moral risk (see C below).

Services
Distributed services can be particularly hazardous. Good examples are gas mains and pipework containing high temperature oil used in process heating or even space heating.

Methods of Storage
High piles or racks are a serious hazard of modern warehouses because they prevent the detection of fire and render sprinklers ineffective.

Sprinkler Systems
By quickly containing a small fire a properly designed and maintained sprinkler system may reduce the cost of a fire by a factor of 1,000. Sprinkler systems can, however, cause a significant wet peril hazard if they are not properly maintained or if proper precautions are not taken against bursts in frosty weather.

Fire Breaks
Underwriters will be wary of large open plan buildings with no fire breaks. Where fire breaks are provided the means of access for employees, materials etc must be properly protected otherwise the fire break will be ineffective.

Contents
The contents of buildings, especially storage areas, are very important. This may be because the goods themselves are inflammable or because, while not inflammable, the goods are easily damaged by heat or smoke. Food and pharmaceuticals are a particular problem because a small fire may cause contamination and total loss of the goods. Burning PVC gives off hydrochloric acid and a small fire in electric cabling can cause a disproportionate amount of damage to sensitive electronic equipment nearby. The method of storage is important: e.g. close tidy stacking excludes air and hinders the spread of fire.

A1.4 Moral Risk

A great many fires are caused by arson not necessarily by the insured. Underwriters will want to form a view of the likelihood of arson by considering the financial standing of the employer, staff/management relations and, to the extent that it is possible, of the moral standing of the employer himself. However moral hazard covers more than the likelihood of downright fraud. For example, safety procedures noted on the proposal form or in the survey will only be as good as the management is in enforcing them. No smoking rules are notorious for being disregarded. General good housekeeping, e.g. tidy working areas and waste regularly swept up will cut down careless fires. What procedures does the management have for ensuring that fire doors are not wedged open, even temporarily? Is the broker or the potential insured having difficulty getting the cover?

There is an underwriters' adage that if you have a bad insured, it does not matter how good the property, you always have a bad risk: you can never rate adequately for moral hazard.

A1.5 Special Perils

Special perils are usually rated according to simple rules with a fixed rate for each peril and few or no rating factors. However there may be provision for loadings for adverse features and commonly lower rates are charged for higher sums insured.

APPENDIX 2: CLAIMS EXPERIENCE FORM

MATERIAL DAMAGE CLAIMS EXPERIENCE
(For risks with annual premium of £1,000 and above)

Name of Insured:

Main addresses:

Main ABI Classification:

Perils Insured:

Renewal Date: LTA Expiry Date:

Date to which experience completed:

Where less than five years' experience, including the current year, is available, name of previous insurer:

Last five years' Losses net of Deductible (if any):-

YEAR	Amounts Paid £	Amounts Outstanding £	TOTAL CLAIMS		DEDUCTIBLE APPLICABLE £ (Other than Standard Excesses)
			No.	Amount £	
19 /19					
19 /19					
19 /19					
19 /19					
19 /19					
TOTALS					

Each large loss during last five years (included in the above details)

YEAR	CAUSE	AMOUNT PAID/OUTSTANDING £

F	=	Fire	S	=	Storm
A	=	Aircraft	FL	=	Flood
Exp	=	Explosion	BP	=	Burst Pipes
R&CC	=	Riot & Civil Commotion	I	=	Impact
MD	=	Malicious Damage	IOV	=	Impact Own Vehicles
Eq	=	Earthquake	BOR	=	Balance of Risks
			Others (specify)		

Signed: ..... Date: .....