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SYNOPSES

FINANCIAL OPTIONS IN LIFE ASSURANCE POLICIES

by

R. G. GILLESPIE

(Synopsis of a paper presented to the Society on 17 March 1981)

The purpose of the paper is to describe very broadly the various methods of dealing with options in life policies and, in particular, to contrast traditional methods of calculation with the new methods developed to deal with maturity guarantees on unit-linked contracts. The paper advocates use of methods of costing and of valuation based on risk theory.

Options are classified under a number of heads, broadly as either mortality options, rate guarantee options, or benefit guarantee options. A distinction is drawn between benefit guarantees on linked contracts and those on non-linked contracts and also between single and annual premium rate guarantees.

The statistical considerations underlying traditional methods of calculation of option premiums are discussed and the calculations are shown to rely on the assumption of independence.

The potential mismatching risk implicit in a guarantee of annual premium rates is identified, although the risk is not great for the usual form of such options.

The problem of reserving for maturity guarantees on unit-linked contracts is discussed, and the paper covers, from a different viewpoint, many of the questions addressed by the Institute Working Party on the subject of maturity guarantees.

The techniques developed by the Working Party are also appropriate for costing of single premium rate guarantees such as, for example, an annuity option on an endowment assurance or deferred annuity.

Continuing benefit guarantees are shown to involve even larger risks than point-in-time guarantees, because of the possible incentive to the policyholder to maximize the guarantee cost.

Lastly the risks implicit in guarantees of surrender values on

non-linked contracts are discussed. Although such guarantees are usual in North America, and although a demand is known to exist in Britain, the potential damage from high and volatile interest rates is judged to be very significant.

The paper concludes in the view that in meeting market demand for flexible options the profession should use modern statistical methods to fully analyse all the risks involved.

THE FINANCIAL MANAGEMENT OF A DEVELOPING LIFE OFFICE

by

D. J. LE GRYS

(Synopsis of a paper presented to the Society on 4 November 1980)

The Financial Management of a Developing Life Office was produced in 1979 and was principally written for managers and directors of newly established Life Offices in the United Kingdom. Most of these offices write non profit and unit-linked types of life assurance business and this book concentrates on the problems related to these policies.

The aim was to produce an outline of the main factors affecting a life office as it developed, and to highlight constraints and dangers.

Chapter 1

The capital requirements for a developing life office are explained and the concept of a 'corridor for development' is defined. Although a new office may be attracting business at profitable terms, the office must keep its production below a maximum production limit otherwise it will exhaust the shareholders' capital. On the other hand the office must reach a certain minimum production limit if it is to trade successfully and to earn profits in the long term.

The five main factors that affect the development of a new life office are defined as the marketing terms, expense performance, investment and reserve requirements, tax position and inflation.

Chapter 2

The need for an adequate premium level is explained. An adequate premium is defined as the premium which, allowing for expected lapses, commission, claims, expenses, frequency of premium and all other variables is likely to leave the life office with an adequate return on capital. The amount of potential profit per sale should also be reasonable relative to the sales effort and the cost of administering the policy.

An example of a projection for testing the adequacy of the premium is shown together with some typical assumptions for a savings policy. The general marketing factors and their effect on both the initial capital requirement and the long-term profits are explained.

Chapter 3

The statutory responsibility of the Appointed Actuary is briefly outlined. Valuation methods and techniques are not dealt with in detail, but the need for adequate reserves is explained. The threats to a life office's solvency are grouped under two broad headings. Firstly under 'Creeping Insolvency' are those factors such as poor trading and management, expense inflation and inadequate returns which lead to a gradually deteriorating position and ever larger transfers from shareholders being required to cover deficiencies in the life fund.

The factors shown as being 'Potentially Crippling' are mismatched investments and guarantees of maturity values, death benefits, surrender values or minimum investment returns. Liquidity problems and other options against the life office are also included in this heading.

The investment responsibility for a life office is shown to be a threefold responsibility of the Directors and general management, the Actuary and the investment managers. The relationship between the responsibilities can be seen from a simplified example.

Chapter 4

One of the major forces affecting the amount of capital and the emergence of profits is the taxation position of the developing office. An example is given showing the new business strain to offices in favourable and unfavourable tax positions. The need for a developing life office to issue single-premium policies is explained and an example of the pricing considerations for income bonds is given.

Chapter 5

The various forms of expense analysis are considered and specimen analyses for a small office are shown. Considerable emphasis is placed on the comparison of actual expenses to the expense margins contained in the premium income to the office.

Chapter 6

Inflation is singled out as the most important threat to life offices and the biggest single factor delaying the emergence of profits. The damaging effects of inflation are considered to be:

(i) Inflation could change policyholders' attitudes to long-term savings.
(ii) Inflation can make all existing business unprofitable.
(iii) Inflation can produce monetary growth faster than budgeted expansion and thereby increase financing strains.

The effect of inflation on profitability, solvency, capital requirements and the tax position are discussed. It is suggested that to combat inflation, offices should build into the premium formula adequate expense assumptions that anticipate some degree of inflation and that on unit-linked products the office should reserve the right to increase margins for expenses if inflation exceeds expectation. It is argued that U.K. offices would be better protected if they issued increasing 'savings' policies of the type which are now widespread in the rest of Europe. The increasing policies have the benefit of:

(i) Increasing the premium income (and the expense contribution) to the office automatically.
(ii) Giving the policyholder a more realistic savings and life assurance plan.

Chapter 7

The final chapter is concerned with measuring the performance of a developing life office. The four main areas where information is required are indentified.

In addition to the normal reporting systems a case is made for a regular 'net asset' evaluation of the office so that shareholders can monitor the performance of their investment. The prime responsibility of the Directors, managers and Actuary is to ensure that

obligations to existing policyholders are met in full. Having satisfied this overriding principle it is a valid question for shareholders to ask if their interests are best served by keeping the life office open and writing the maximum level of new business, writing a restricted level of business or closing the office to new business altogether. The importance of continuing viability studies and corporate plans to answer these critical questions is emphasized.

INDEX-LINKING IN THE U.K.

by

D. H. NEWTON

(Synopsis of a paper presented to the Society on 16 December 1980)

During recent years, the United Kingdom has experienced high and variable rates of inflation. Consideration has therefore been given to techniques, like indexation, which may help to reduce the impact of inflation.

The paper surveys the many areas where some form of index-linking has been introduced in this country. It then discusses the theoretical economic arguments for and against indexation. Whether indexation will help to reduce inflation or increase the inflationary pressures is not clear. The major argument for introducing index-linking is that it helps reduce the inequities caused by inflation, in particular for long-term contracts where the risks and uncertainties are even greater. The indexation of specific short-term contracts—wages and taxes—is therefore only briefly considered and the paper concentrates on the areas of pensions and fixed interest investments.

Since the paper was presented there have been two issues of index-linked gilts, restricted to pension funds and the pensions liabilities of insurance companies; at issue the first gave a real return of 2%, the second $2\frac{7}{8}$%. At the latter rate of return pension funds will nearly obtain the return they expect on average from all their assets and it is guaranteed. One would expect pension funds to be prepared to invest a reasonable proportion of their assets into such a security.

Pensions are at the forefront of the public discussion about indexation. There is a division between the public sector which in

general gives inflation-proof pensions, and the private sector which does not. However, many private sector pensioners have received significant *ad hoc* and fixed increases in pensions. There is therefore pressure for more conformity of pensions arrangements. The abandoning of index-linked pensions in the public sector would be a retrograde step; the alternative would be for the private sector to guarantee its pensioners greater protection against inflation.

There are two major obstacles to the private sector providing index-linked pensions; firstly can industry guarantee to pay open-ended nominal liabilities over which it has no control, and secondly will the costs be too high? The government could help overcome the first problem either by issuing index-linked bonds or offering to accept the liability for pension increases for a pre-arranged sum. The costs of introducing index-linked pensions are very high; it could increase the cost of pensions by 70%, although there are some off-setting factors. It is therefore worth considering whether pensioners should not receive a lower pension which would then be index-linked. Then they will be able to retain their standard of living as they get older, albeit a lower one.

In some cases the practical difficulties and possible adverse repercussions elsewhere in the economy outweigh the benefit to be derived from the introduction of indexation. However, there are definite advantages to be gained from indexing private sector occupational pensions. The present debate should therefore concentrate on ways to improve private sector benefits rather than envious criticism of those who have the security of a pension which will not be eroded by inflation.

ACTUARIAL MANAGEMENT OF A UNIT-LINKED OFFICE

by

M. IQBAL

(Synopsis of a paper presented to the Society on 6 January 1981)

The terms upon which the office transacts business should be judged within the overall constraint of the office's long- and short-term corporate objectives. The two most common objectives are a specific rate of return on capital employed and a specific increase

in the net worth of the office. If it is the former, the rate at which the stream of future surplus equates to the initial strain is a net rate. The rate of discount at which the net worth is computed would also be a 'net' rate, although care must be taken to adjust the surplus on the pension contracts for tax at the appropriate rate.

The categorization of contracts into categories A to D by Grant & Kingsnorth (J.I.A. 93, 387) is no longer relevant. Category B contracts are largely obsolete and investment performance guarantees are of limited interest.

The current range of contracts can be categorized as follows:

Type 1: Office invests $x\%$ of the first n premiums and $y\%$ of the balance. All income is reinvested but an annual charge retained. Surrender Value is the value of the units possibly with a sterling penalty.

Type 2: A constant percentage of each premium is invested. The first n premiums are invested in units ('capital units') that attract a higher management change than those to which premiums are allocated subsequently. Income is reinvested. Surrender Value is the value of capital units multiplied by $\bar{A}_{x+t:\overline{n-t}|}$ plus value of other units, possibly with a sterling penalty.

Type 3: A limiting case of Type 1, with $x = y$.

Type 4: A modification of one of the previous types. The risk premium cost of the life cover from time to time is met by cancelling sufficient units.

Type 5: This is a single premium whole life policy, the office investing typically 95% of the premium. An annual charge is deducted from the fund.

The return available under a contract depends crucially upon the office's tax position, lapse experience, the volume of business obtained, expense inflation. By suitable design it is possible to minimize the effect of lapses and inflation, but tax and business volumes remain as problems.

The primary objective of valuation is to ensure solvency and any surplus so revealed is distributable. However, there may be occasions where a more stringent basis may be used in order to either delay or smooth out the emergence of surplus. The extent to which separate contingency reserves need to be held depends upon the precise design of the contracts.

It is important to have a thorough understanding of the nature of

operational expenses incurred by the office. Expenses should be split into direct new business, direct renewal, selling and overheads. An expense analysis ought to be carried out to measure these and subsequently actual expenses must be monitored against forecast.

There are four principal sales outlets: direct sales, broker, professional intermediary and mass marketing. With direct salesmen the overall acquisition cost is generally higher and one has the problem of selection and training. However, within reason the office has control over their activities. The broker acquisition costs are generally lower but the office has no control over them and often the contract needs to be quite competitive. Mass marketing is still in its infancy in this country.

COMPUTER TECHNIQUES FOR DEVELOPING PREMIUM RATES

by

N. STEPHENS

(Synopsis of a paper presented to the Society on 17 February 1981)

The paper shows the basic methods used to produce premium rates on a computer. It is aimed primarily at students but would also be of interest to those in the actuarial profession who have previously used only commutation functions to evaluate premium rates.

The paper is in two parts—the first showing how, by returning to first principles and summing all values, commutation functions are no longer required. The second part gives the basic steps required to produce a cash flow program which may be used to check premium rates, profitability and bonus levels of new or existing policies. Whilst commutation functions may still have a place in actuarial calculations it is not possible to employ them where, for instance, interest rates are assumed to vary with elapsed term or where withdrawal rates also are included as a decrement. The paper shows how these sorts of assumptions can be simply included in a computer model, although it is pointed out that the results obtained should be carefully compared with rates produced assuming level interest rates and no withdrawals.

Numerous simple flow diagrams are used to demonstrate the

methods used to calculate, store and print premium rates. At the end of the section it is shown how annuity rates may also be computerized, in particular a flow diagram for calculating capital-protected escalating annuities is included.

The second part of the paper, dealing with cash flow programs, gives some examples to show how the premium rates calculated in the first part may be checked. (The projected fund per life at the end of the term of an endowment assurance being equal to the estimated maturity value of each policy.)

Using the same program for a group of policies which have already been in force a number of years it is thus possible to ascertain whether there will be sufficient moneys available on differing future assumptions to meet the maturity liabilities as they emerge.

THE FINANCING OF PRIVATE OCCUPATIONAL PENSION SCHEMES

by

R. B. ABRAMSON AND S. A. CARNE

(Synopsis of a paper presented to the Society on 20 January 1981)

IN the U.K. and the U.S.A. most occupational pension schemes are funded in advance; in France such schemes are run on a pay-as-you-go basis; in West Germany, book (or internal) reserves are the predominant method. There is a tendency for each nation to regard its own method as the most suitable. In this paper the authors have set out to examine the principles of these various systems of pension financing, not in order to advocate any particular system but rather to promote a better understanding.

Companies in the private sector must be profitable if they are to survive. The authors devote a substantial part of the paper to analysing the effects of each financing method on the profits of the supporting employer. The popular view is that funding is cheaper if the assets earn a real return (and more expensive otherwise); this is shown to be a myth. Arguments are put which show that where a whole industry opts for pay-as-you-go the level of profits will be much the same as if the pensions had been funded in advance—it is the price of the industry's products that will differ.

The question of security is also examined. An important aspect of any method of pension scheme finance is the security offered to members in the event of the supporting employer's collapse. External funding has obvious merits in this respect, but, after all, in West Germany and France companies do go out of business without leaving the employee empty-handed in retirement. The paper examines how this is achieved.

The paper begins with an overview of pension provision, considering general economic and demographic factors. For example, one well-known argument against the pay-as-you-go system is that it becomes more expensive with an ageing population, but it is pointed out that demographic movements must have significant consequences for *any* system of financing in view of the underlying reliance of all pensioners on current production. This is shown to be true even with a system of externally funded schemes. In such a system the calls on the private sector, through equity dividends, and on the taxpayer, through government stock payments, would have to be spread over a reduced working population.

In the closing section of the paper the operation of a book reserve is considered and the authors examine some novel problems that arise in this area. In particular they consider how one may determine the interest addition to the book reserve, and the consequences for the actuarial valuation. It is pointed out that the close relationship between salary increases and interest rates traditionally looked for in pension funds may break down. Furthermore, whilst the concept of valuation surplus or deficit is useful to maintain a stable contribution rate for pension funds there are technical difficulties in applying this approach to book reserves.

Other topics considered include the question of pensions and company accounts (important because of the possible effect on financing methods), and legislative requirements in the U.K.

AVIATION INSURANCE

by

G. E. LYONS

(Synopsis of a paper presented to the Society on 3 February 1981)

THE paper investigates the feasibility of using the techniques of

probability and simulation to determine guide rates for aviation insurance. The various classes of aviation business considered are as follows:

(i) *Hulls*

Worldwide experience has shown that markedly different loss rates are applicable to different aircraft. The premium rate for a fleet of aircraft will be based on:

(*a*) specification of the fleet: the number of each type of aircraft
(*b*) underlying loss rates
(*c*) value of each aircraft

In practice the rate charged will also be affected by the operator's experience and the area of operation. Cover for partial losses would be determined by applying a loading factor of around 100/70 to 100/50 of the premium for total losses.

(ii) *Passenger Liability*

The assessment of the premium for this class of business is seriously hampered by the difficulty in estimating settlement levels. Liability may be subject to Warsaw conventions or be unlimited as in America. The major problem is that of secrecy as insurance companies are unwilling to divulge out-of-court settlements.

(iii) *Product Liability*

This covers manufacturers against product failures and requires detailed understanding of the products' technical aspects.

Thus, for rating purposes only hulls business can be considered amenable to statistical analysis with the data currently available. The paper analyses numbers of total losses and rates of total loss by aircraft year for jet aircraft with the aim of determining hull premium rates.

Loss Rates for Jet Aircraft

The number of jet aircraft in commercial service has increased

rapidly since their introduction in 1958, accompanied by steady improvements in reliability, as the following table shows:

Table 1. *All Jet Aircraft*

Average loss rate	*Year*	*Aircraft in service*
·01	1963	798
·0075	1967	1,917
·005	1973	4,306
·004	1976	5,026
·003	1980	n/k

Examination of the pattern of loss rate levels of different aircraft are considered and used to find the underlying loss rates of the main types of jet aircraft. These are shown in the following table:

Table 2.

Aircraft	*Underlying loss rate*
Boeing 707/720	·006
Boeing 727	·002
Boeing 737	·003
Boeing 747	·003
Douglas DC8	·005
Douglas DC9	·0025
Douglas DC10	·005
BAC 1-11	·006
BAC VC10	·006
Caravelle	·006
Corvair 880/990	·01
Fokker F.28	·014
H.S. Trident	·005
Lockheed Tristar	·002

Values of Aircraft

Aircraft are usually insured for replacement value in U.S. dollars. Table 3 in the paper shows ranges of values of the various models of the above aircraft.

Rating Examples

A small fleet is considered showing the calculation of the pure premium and standard deviation. The total premium would consist of the pure premium plus a loading to take account of the variance. For excess of loss rating a program has been developed using a

mini-computer to give the expected average excess claim amount and hence the risk premium for any particular retention. Two basic approaches have been used to model hull total loss business.

(1) A random number generator is used to simulate the experience of a fleet of aircraft for a large number of years of experience.
(2) Multinominals are used to obtain the exact distribution.

Conclusion

Considerable data are available on aircraft experience from such sources as Airclaims Service. This data can be used to determine guide rates for Fleet rating and excess of loss business although a lot more research is required particularly in the areas of partial losses and passenger liabilities for which additional data will be required.

Appendices

(1) Tables of exposures, losses and loss rates
(2) Graphs of loss rates by calendar year
(3) Example of historical development of claims and settlements: DC10 crash near Paris in 1974
(4) Table of fatalities for all jet aircraft.

SOME TRENDS IN INVESTMENT MARKETS

by

D. I. W. REYNOLDS

(Synopsis of a paper presented to the Society on 31 March 1981)

THIS paper was originally presented to the Manchester Actuarial Society in December 1979. It was particularly appropriate at that time to look forward to a new decade. The three previous decades had shown that different factors can dominate the movements in interest rates and stockmarkets. In the 1950's assessment of the risks involved in equity investment resulted in ordinary shares showing higher yields than on fixed interest investments. The 1960's brought the reverse yield gap but in the 1970's it was the levels of and trends in interest rates which dominated movements in the ordinary share market.

The first section of the paper considers the trends in interest rates to higher but more variable levels. During the 1950's Bank Rate (Minimum Lending Rate in recent years) averaged 3·96%; rising to 5·93% in the next decade and to 9·59% in the 1970's. Coupons on U.K. Government securities which had been as low as $1\frac{3}{4}\%$ in 1952 rose to over 15% in 1976 and 1979. Bank rate changed 14 times in the 1950's, 24 times in the 1960's and 87 times in the 1970's. These trends were not only a U.K. phenomenon. The use of pragmatic monetarism with high borrowing requirements produced similar effects elsewhere but even the excellent U.K. gilt market was hard pressed to meet the Government's borrowing needs without innovations such as partly-paid and variable coupon stocks.

As the expectations of investors are an important influence on share prices, the second section deals with the nature of investors in U.K. ordinary shares and how they have changed over the 1970's. Total personal wealth has moved from stocks and shares into physical assets, mainly dwellings. Savings have increased as a percentage of personal income with much of it directed through institutions including pension funds. Insurance companies and pension funds have increased their holdings as a proportion of total U.K. listed ordinary shares from one-third in 1970 to over half by 1979. Such growth has wrought changes in stockbroking to serve the new breed of investment manager. Firms of stockbrokers have reduced in number but increased in size so as to provide the economic advice and investment analysis required by the institutions.

The final section of the paper speculates on changes which might take place in the 1980's. Despite numerous forecasts of the increasing importance of the institutions, there are a number of reasons for their cash flow to moderate as a percentage of GDP in the next decade. Movements towards fiscal neutrality can be expected but not direction of investment. The measurement of investment performance is becoming more extensive but despite its substantial benefits, it does have disadvantages as investment horizons are shortened and some conformity of investment policy can occur. Index funds may result but they are expected to have only a short period in vogue. Index-linked securities are not expected to be issued to any great extent but the corporate debenture market should re-open. The reward of stockbrokers by commissions alone may change with separate charges for economic and company research replacing the present commission system.