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**DIRECT SALES FORCES
NOW AND IN THE FUTURE**

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1. Setting the Scene

1.1 Objective of Paper

The purpose of this paper is two-fold:

- To set out the current use of representative based distribution of life assurance in the UK and overseas and look at the trends.
- To describe some techniques that can be useful in modelling representative based distribution.

1.2 Types of Distribution System

Any provider of financial services is dependent on new business for long term survival. Distribution of these services must be managed to enable strategic targets to be met. Modelling can help an understanding of the relative importance of the different factors that contribute to the financial outcome. A model is also a valuable planning tool.

For life assurance there are three main types of distribution:

- **Intermediary-Based;**
- **Representative-Based;**
- **Direct Response Distribution.**

Under an **intermediary-based** system, the intermediary is the agent of the client, and selects from the products of a range of providers. Under a **representative-based** system, the representative is the agent of the provider. The provider and representative are contractually bound for some or all of the products offered. Representatives could include, for example, full-time assurance sales associates or businesses whose primary activity is not life assurance. **Direct response** distribution, also referred to as **direct marketing**, includes techniques such as direct mail and advertising in periodicals.

Within the UK, polarisation has made the distribution methods fairly distinct. In markets other than the UK, distinctions may not be as clear.

This paper concentrates on aspects of representative-based distribution systems. In particular, it looks at the use of agent sales forces which are bound to the product producer. These are referred to as **direct sales forces**. Note the distinction between direct sales (representative based) and direct marketing (direct response). We refer to the staff of direct sales forces as **sales associates**. This would include, in most cases, bancassurance sales staff. The principles of modelling are, in many cases, applicable to other distribution channels.

2. UK Experience

2.1 Market Penetration

Direct sales forces (including bancassurance) still distribute the majority of UK life assurance. They have, however, taken a declining market share:

New Yearly Premiums - Proportion of Life and Pensions Business by Channel of Distribution

<i>Year</i>	<i>Independent Intermediaries</i>	<i>Tied Agents</i>	<i>Other Company Staff</i>	<i>Direct Marketing</i>
1992	29%	10%	58%	2%
1993	28%	9%	60%	3%
1994	30%	8%	59%	3%
1995	35%	7%	55%	3%
1996	37%	8%	52%	3%
1997 Q2	44%	8%	46%	3%

Source: ABI

This reflects the position within the life and pensions market. Life and pensions products are themselves under competition from other savings and investment media.

In terms of relative costs of distribution, most analyses suggest that average costs compare as follows:

Tied Agency dearer than Direct Sales dearer than Intermediary Based

Direct sales might be expected to be more costly than the intermediary channel, as direct sales tend to be to lower net worth clients resulting in smaller mean policy sizes.

Analysis also suggests that insurers with multiple distribution channels tend to have higher expense ratios than those using a single channel. Again, this might be expected as there are additional costs in supporting a product range, or ranges, suitable for more than one channel.

2.2 Direct Sales - Production Measures

The table in 2.1 shows how the direct sales market share has declined. More marked still has been the decline in the number of individuals registered to transact tied business:

<i>Year</i>	<i>Number of Individuals</i>
January 1994	111,300
January 1995	85,000
January 1996	77,000
January 1997	62,500
October 1997	57,200

Source: Registration Services Department, PIA

Looking back to previous years, even higher numbers of individuals were registered (180,000 at the start of 1990). The decreases before 1994 included those resulting from changes in the practice of registration, as well as declines in the number of active sales associates. There was a change in practice in 1995, which meant that high street bank staff providing advice on regulated products were also included in these numbers. This increased the numbers registered in 1995 by around 12,000.

In many cases the headcount of individual sales forces has fallen. There has also been contraction through corporate change.

- Acquisition /Merger of insurers: These changes may not automatically bring about a reduction in sales associate headcount, but the uncertainty and administrative upheaval may well result in some reduction.
- Closure or disposal of a sales force whilst maintaining other distribution channels.
- Closure of an insurer to new business.

Another factor to consider is productivity per sales associate. This varies widely between sales forces.

Annualised New Business Premiums per sales associate for 1995:

First Quartile	£63,241
Median	£33,621
Third Quartile	£15,438

Source: Datamonitor - 43 insurers surveyed

The highest and lowest values in this survey are even more extreme (around £1 million and £7,000 respectively). There are good reasons why some variation would be expected.

- Basis of measurement. This is calculated as total new business divided by the number of sales staff. The definition of total new business should be fairly straightforward. However, treatment of staff numbers may vary. For example, are new recruits in the initial stages of training included? How are sales by managers, or staff with both sales and supervisory roles treated?
- Maturity of sales force. Some of the companies reporting poor performance are those where the sales force is very new. In this case productivity would be expected to be low, as sales associates will in general be inexperienced.
- Target market. Sales forces selling to high net worth individuals would be expected to sell larger policies, on average, and hence have higher annual production. Also, different products generate different margins. For example, protection products tend to provide greater loadings per pound of premium than savings products. Sales forces selling more protection business may not need such high levels of production in premium terms.
- Sales strategy. Some sales forces expect associates to be 'hunters', obtaining their own clients and booking appointments themselves. Other sales forces will expect associates to be 'farmers' - using an existing client bank. The insurer may provide administration services such as booking appointments with clients. The first approach might give lower production per associate, but would also give lower administration costs.
- Treatment of non-life. It appears that non-life products (e.g. PEPs, unit trusts, or even some general insurance products) are not included on the analysis. Some sales forces may obtain a significant proportion of their production from such business.

Despite these differences, the range of productivity shown is very great. It seems questionable whether established sales forces with the lower production levels can be, or will become, financially self supporting.

2.3 Regulation

The UK regulatory regime has had a significant effect on the way in which products are distributed.

It has increased the requirements for training of sales associates and led to a more professional approach to selling. It has increased the costs of distribution. An understanding of the regulations, and the way they are implemented in a particular insurance company, can help in modelling. This understanding can help explain the management structures of the sales force and the periods of training needed before sales are permitted.

2.4 Recent Regulation - the Financial Planning Certificate (FPC)

One feature of life assurance regulation that came to prominence in 1997 was the examination requirement of the Financial Planning Certificate or FPC.

This had a significant effect because of deadlines for existing staff to pass the exams. Studying for and sitting the exams has reduced the time available for sales associates to sell. It has also led to some unsuccessful staff leaving the industry. In at least two cases companies have had to suspend sales whilst records are reviewed to check compliance with the regulations.

So what are the requirements?

The PIA rules have always required (Rule 2.1) that individuals must not be appointed as representatives, unless they are of 'good character and of the requisite aptitude', and have complied with training and competence requirements of the firm. This applies equally to financial intermediaries and company representatives. Rule 2.6 sets out the requirements for setting up a training and competence scheme. It should be noted that the scope of the Training and Competence requirements is far broader than just passing the FPC.

On being appointed a new entrant must undergo **Stage One** training. This includes:

- gaining general financial services knowledge;
- knowledge of relevant systems and procedures of the firm;
- gaining specific product knowledge;
- skills in analysing customers needs and circumstances;
- studying for and passing Financial Planning Certificate Paper 1 (FPC1) or equivalent;

- formal assessment of knowledge and its application.

During this training, new entrants are not permitted to give investment advice, or carry out any investment business activity with a customer unless accompanied by a supervisor.

Once Stage One is completed, **Stage Two** training is undertaken. This includes:

- training in the application of relevant knowledge and skills in meetings and other dealings with customers;
- giving investment advice, under direct supervision, but with gradually increasing responsibility;
- studying for and passing Financial Planning Certificate Papers 2 and 3 (FPC2 and FPC3) or equivalent;
- formal assessment of knowledge, its application, and competence in acting as an adviser.

At the end of this stage, if the assessment is successful, the new entrant is classified as a **competent adviser**. There is a requirement for ongoing supervision of competent advisers and for them to undertake a programme of Continuing Professional Development.

There is no specific timescale for completing Stage One. However, classification as a competent adviser should occur within two years of commencement. If this does not happen, a further year of direct supervision is allowed, otherwise no more investment advice can be given. Transition arrangements were set up for existing advisers, who had to complete the Financial Planning Certificate by 1st July 1997 or require further direct supervision. This requirement led to a rush of exam sittings and re-sittings as the deadline approached.

There is also guidance on preventing representatives in training moving employment in order to 're-set' the two year time limit.

Supervision and training of staff, particularly during Stage One, is labour intensive and costly. The PIA do not set explicit targets for supervisor ratios, which must take account of the specific circumstances of the company. Clearly though, modelling of a sales force must take account of the management and supervisory effort required.

2.5 Remuneration

Historically, direct sales forces received only commissions. Low training requirements meant sales associates could sell soon after appointment. There were few other outlets for life and pensions products, and the range of alternative savings and investment media was also limited. Customers were therefore less able to shop elsewhere for financial services. It was possible for an insurer to recruit large numbers of potential sales associates, aware that few would be successful, but with only limited capital outlay for the unsuccessful candidates. Whether this allowed the insurers to present a strong brand image or maintain a high quality sales process to foster repeat business is a separate matter.

More recently there has been a trend towards remuneration through a fixed salary plus production bonuses. The relative proportions of salary and bonus vary but, typically, for an agent reaching target, salary would still form the majority of pay. Other benefits might be offered such as a company car, healthcare or life cover. Sometimes these are dependent on career duration or achievement of particular sales levels. The change to salary plus bonus has not been universal however.

Reasons for changes to salary systems include:

- A need to subsidise staff through an initial training and development period whilst production is low.
- Branding and marketing strategy may require tight control over the method of sales activity and client contact. This may be more readily accomplished with an employed sales force reinforced by salaried status.
- Finally, competitive pressure from other insurers for sales associates may have led some offices to add a salaried structure. This is rarely the sole reason. It is certainly not a strong one if not in line with other strategic objectives.

Customer perception of commission-based sales associates is sometimes quoted as a reason for change. The validity of this argument is questionable. Customers would apparently prefer to deal with sales associates who do not have a direct financial incentive in an individual sale. In most cases, a change to a salaried structure will not have any real impact on this. A poor performing sales associate will need to make sales to ensure his or her continued employment. A high performing sales associate will be aware of the impact of an individual sale on their bonus.

2.6 The Outlook for UK Direct Sales

A recent history of declining market share, falling numbers employed and increases in cost do not give great encouragement for the future of sales forces. Nonetheless, commentators have come to different views about the prospects for sales forces and for life insurers as a whole.

We would not put ourselves forward as marketing specialists. However, based on our knowledge of current circumstances, our views are that:

- Direct sales staff numbers will continue to decline. This will occur through continued consolidation of the number of life insurers and through insurers continuing to reduce their recruitment of new staff. This will mainly affect traditional insurers rather than bancassurance.
- Market share of direct sales forces will continue to decline due to increased competition from other channels.
- Direct sales will continue to be forced out of sales to lower net worth individuals by the high costs of training and sales force support. This has been a feature of Home Service business in the recent past.
- Direct sales can continue to be a major element of UK life distribution, provided:
 - ◆ companies are focused in their training and recruitment of staff;
 - ◆ companies maintain high productivity per head;
 - ◆ companies ensure their sales associates provide an image of quality to clients.

We do not believe, contrary to other commentators, that smaller sales forces are necessarily non-viable. The argument for non-viability is that, with a small sales force, fixed costs are not spread sufficiently. We agree that a direct sales force can be costly. However, we feel that whilst some of these costs have some fixed element, many are proportional to the number of sales staff employed. Remuneration of sales associates, including initial subsidies, and line management costs, will be proportional to the number of staff employed. Indeed, large sales forces run a risk of increased costs through a proliferation of management structures.

Two areas where a large sales force is at an advantage are in the provision of point of sale (POS) technology (laptop computers) and in product development. The provision of POS technology will involve large fixed costs. However, the use of POS technology is by no means universal and some companies are very successful without this. Development and maintenance of a broad range of products can also be capital intensive. This, however, can be a feature of any small life insurer, not just those with direct sales distribution. A direct sales distributor can limit such costs by making use of a tight range of products, focused on their target market. Some 'outsourcing' may also be

possible, for example through use of 're-badged' PEPs or unit trusts from other financial services companies.

What is clear is that production per head varies massively between companies. This reflects a wide range of business effectiveness. Size may be important but is not as important as quality of management. Well run small direct sales forces are far more effective than poorly run large ones and this will continue to be the case.

To sum up, direct sales forces offer an expensive service (*face-to-face financial planning, usually in the client's home, and offering the products of a single insurer*). The risk is that this service is something that nobody will buy, or be sold. Successful companies will be those that ensure that this service is as relevant as possible to their target market and is delivered at an acceptably low cost.

3. A Look Overseas

3.1 Objective

In this section we discuss life markets in the US, continental Europe and Ireland, considering different aspects of each.

Within the US the financial analysis of distribution methods has developed over a long period of time, partly because of the particular distribution strategies used. We look at those strategies and consider whether there are valuable lessons that can be transferred to the UK, independently of the distribution strategy.

Many continental life markets are less developed than the UK, at least from an actuarial perspective. We examine which distribution strategies are likely to be most appropriate. In particular, what are the opportunities for direct sales forces?

There are considerable similarities between the Irish and UK life markets. We explain the regulatory differences.

3.2 General Comments

There are two important features of the UK market. When examining other life markets it is important to remember that these features do not generally apply.

Polarisation: One of the most significant impacts of the Financial Services Act was the introduction of polarisation. This requires that an insurance intermediary may either advise on the products of only one life insurer or must be able to advise on the products of all life insurers. Overseas, where polarisation does not apply, intermediaries may choose to offer only the products of a few providers, use a different provider for each class of product they sell, or some other combination.

Commission Bias: Remuneration of intermediaries must not induce the intermediary to recommend one product over another, if this is not in the client's interest. Absence of this rule elsewhere does not imply that poor advice is given. However, it does constrain UK remuneration structures in a way that other remuneration structures may not be constrained. As an example, a UK insurer would need to be very careful in offering an incentive scheme that provided cash prizes based only on production of a single class of product.

3.3 The US Market

Subject to the above comments, US systems of distribution show some similarity to those of the UK. The terminology however is different. There are also significant differences of emphasis in sales management structures.

Sellers of life assurance are categorised as:

- **Exclusive Agents:** also referred to as **career agents**. These will be affiliated to a single product provider. They often can, and do, place business elsewhere. They will typically receive commission and/or salary, plus training and administration services from their principal office.
- **Brokers:** these will transact business with a range of providers. As such, they will receive remuneration as commission and production bonus. They may also be provided with some services by the offices with which they transact business. This category may include businesses or individuals who do not primarily transact life assurance.
- **Personal-Producing General Agents (PPGAs):** this is effectively a form of brokerage system. Qualified life assurance sales staff have links with a number of life assurers. They will primarily receive production based remuneration, although some further services may be provided. They may have the right to appoint sub-agents, who will then receive a proportion of the total remuneration. In practice, the distinction between PPGA and brokerage is often slight.

Within each of the above structures, field managers may be either employees of the insurer or independent contractors. For example, exclusive agents may be appointed and managed through an **agency manager** (employed) or a **general agent** (independent). A general agent assumes a greater business risk, in theory financing the equity stake in the branch operation. In practice, given the degree of initial support provided by offices to general agents, the equity is diluted. Agency managers may have production and other incentives. Hence the practical difference between agency managers and general agents can be slight.

Another important feature of US life insurance distribution is the New York State legislation regarding maximum remuneration scales. This can extend its scope to business transacted outside New York State, if offices transact any life business within the state. The effect of this legislation is to affect the amount and form of remuneration paid by such companies. Typically the amount of sales remuneration paid by such companies is lower than that for non New York companies.

Remuneration structures vary widely, dependent on the channel of distribution and the company. One feature of note is the format of renewal commissions. US practice has historically distinguished between:

- **Vested and Non Vested Commissions:** vested commissions continue after an agent or broker ceases work or their contract ceases. Non vested commissions cease once a contract is terminated. Vested commissions may, for example, continue into retirement. Fully vested commissions are becoming less common.
- **Service Fees and Renewal Commissions:** some companies separately identify service fees (payment in respect of work continuing to service the client) from renewal commissions. Renewal commissions can be seen more as a deferred reward for the initial sale.
- **Transferable and Non Transferable Commissions:** Transferable commissions would be redirected to a new agent or broker if the responsibility for servicing the client is transferred. Non transferable commissions would typically cease in this event. Again this reflects a distinction between servicing and deferred reward. Transferable commissions can be used to counter potential gains for the new agent or broker from 'churning' of business.

Consideration of these distinctions may be useful in structuring remuneration packages, since it focuses consideration on the purposes of different elements of reward.

As with the UK, career agents continue to make a significant proportion of life assurance sales. However, life assurance is under increasing competition from other savings and investment media. Costs of distribution through agents are high. This is resulting in market consolidation. It is also resulting in some attempts to move away from traditional remuneration structures. This includes consideration of salary plus bonus structures or commission schedules that are more level through the term of a policy. Some insurers have also experimented with profit sharing arrangements. Their general agents have a pooled interest in a reinsurance subsidiary. This gives the general agents a more direct interest in the financial health of the business overall.

Financial management has emphasised financial effectiveness and suitability of remuneration structures at the branch level. The different philosophies of the two types of branch structure (general agency or agency manager) highlight the importance of knowing what responsibility the branch manager has. For example does the branch manager have discretion over their office rental costs? Would they be able to move to a cheaper office if they wanted to? How should this affect their earnings? In their purest forms a general agent would keep all of the saving whilst an agency manager would get none. Insurers have tried to

obtain the most effective blend of the two approaches. In practice there is often a lot of similarity in the remuneration plans. Remuneration is refined to include a large number of factors. Agency managers' remuneration is often linked to the expenses that are under their control. Incentives for agency recruitment are also common. These aim to reward quality of recruits as well as numbers.

Various methods are used to examine the effectiveness of branches, including some akin to added value calculations. This might help to compare, for example, a new agency, incurring development costs and with inexperienced agents, with a more mature agency, where production is high but future growth is limited.

There is a considerable history of actuarial involvement in US sales remuneration. This dates back as far as 1924, with the publication of Linton's persistency table. One common technique is required by New York legislation. This requires a demonstration of the present values of overall remuneration packages as a proportion of product premium. The approach used requires separate decrements for policy and agent persistency, and discounts to the present value of future payments. The changes in agent persistency with career duration and the mix of agents by career duration are taken into account. Industry tables of policy and agent persistency are published by LIMRA for this purpose. Of course, these are not always applicable to particular organisations.

As an aside, it is interesting that the debate about the relative merits of commission and salary based remuneration has been under discussion for many years in the US. In 1869, an editorial in the Insurance Times suggested salaried systems would predominate. It argued that this would be needed to attract back agents who had prospered during the American Civil War, but then left the industry. In the same year, an editorial in the Insurance Monitor noted that only poorer performing agents would opt for salaries, the good performers all requesting commission based terms. Subsequent history would seem to suggest that there is no solution that is correct in all circumstances.

3.4 Continental European Markets

An understanding of existing life markets is necessary in order to consider the opportunities for sales force distribution within Europe. UK regulation focuses on the distribution of business. It allows a large degree of freedom regarding the products offered. In many continental markets the opposite has been true. Commonly there has been little in the way of formal training requirements for intermediaries and polarisation has not been applied. However, regulation of products has often been very strict.

Of course each national market has its own unique features. In a section as brief as this generalisation is inevitable. However, the markets can be placed in three distinct groups by looking at the common characteristics.

- **Advanced:** In these markets life purchases per capita are generally high. There is a range of products available and consumers have become reasonably sophisticated in choosing between them. These markets are typified by the Netherlands and France.
- **Liberalising:** These are markets which up until recently were subject to a high degree of product standardisation, whether imposed by regulation or market practice. In some countries all providers sold identical (tariff) products. In others, products had to be approved by the regulatory authorities who may have had a narrow view of acceptable designs. In yet other countries, the conservatism of consumers, intermediaries and insurers stifled innovation. The products sold were often fairly conservative, commonly endowments or pure endowments investing in fixed interest securities. Product regulation has now ended, either before or at the implementation of the Third Life Directive. In some of these markets life premiums per capita have been high, in others they have been low. These markets are typified by Germany, Italy, Spain, Switzerland and Austria. Belgium falls between the liberalising and advanced groups.
- **Emerging:** These are markets where the life market is small but expanding. There is often little regulation of products or distribution. These markets are typified by Greece and Eastern Europe.

A correlation exists between the type of market and the distribution methods commonly employed. In the advanced markets distribution channels have developed which enable the consumer to distinguish between different providers and products. In France the main emphasis in competition has been on price, partly because much of the business sold is relatively transparent investment products. This has led to the dominance of bancassurance as a distribution medium. In the Netherlands the broker channel is dominant as it is well suited to giving personal advice on the generally more complex products sold there.

In liberalising markets tied agents have formed the most common distribution channel. There was little to differentiate providers through their products or the returns to policyholders. Companies competed by offering a face to face service. In some markets non-life as well as life business was sold by the same agents which, coupled with the narrow range of products available led to little specialist life knowledge among agents. As the markets start to liberalise,

alternative distribution channels, more suitable to a more competitive environment, are becoming more significant.

In emerging markets there is little distribution infrastructure. Providers must build their own distribution networks, usually direct sales forces.

In most of continental Europe the value of unfunded State pensions is far higher than in the UK. Demographic factors make the cost of these insupportable in the medium to long term. Pension reform has started in some countries. Spain, for example, is introducing legislation requiring almost all employers to set up occupational pension schemes. Other countries must take action at some time. Already many individuals are starting to save for their retirement, expecting that the value of state benefits must fall by the time they retire (for example in France). Non-insurance investments may feature as part of pension provision in some countries. The potential for insurers is still huge.

Economic factors are also playing a part in changing the types of products sold. Historically the underlying investments used for life policies have been fixed interest securities. The profit sharing products sold very typically offered guaranteed rates of return at maturity and on all surrenders, making fixed interest securities the most appropriate underlying asset. Also, alternative underlying investments (such as equities) have been less readily available and less accepted by the public than in the UK. In a low interest environment the public is showing greater interest in other underlying investments and equity markets are becoming more developed. The scope for improving the market share of equity linked products is improving.

New products can benefit consumers. They can target needs more accurately and provide more investment flexibility. New products can also be more profitable to the insurer. They can allow greater margins to be taken whilst being more capital efficient. They can hence create an opportunity to increase market share.

There are three constraints which slow down the pace of product reform to a lesser or greater degree. A lack of choice has often led to conservatism amongst consumers who are still suspicious and/or lacking in knowledge about alternative underlying investments or product types. An education process has to take place before they become more financially sophisticated and more adventurous with their requirements. A similar principle applies to intermediaries, particularly in markets where life specialists are rare. Their existing knowledge may be sufficient to advise on a narrow range of simple products. They may need further training and perhaps greater professionalism to give advice on more complex or more targeted products. If the demand from consumers for new products is low the incentive for intermediaries to

make the change will also be low. Past evidence points to many cases of insurers introducing innovative products only to find that intermediaries are unwilling to sell them. Finally, in spite of the Third Life Directive, local taxation practices can make certain product types unattractive.

So where are the main opportunities for sales forces?

In advanced markets the trend has been for the market share of sales forces to diminish and this looks set to continue. Price or independent advice are the major competitive factors affecting distribution in these markets.

Sales forces are well suited to meet the opportunities available within liberalising markets. The demand for new products is increasing. Traditional insurers may be slow to introduce such products. Traditional distributors will be unwilling to sell them. Other insurers will be able to gain a temporary competitive advantage by introducing new products and quickly developing an effective way of distributing them to satisfy consumer demand. The capital cost of setting up or expanding a sales force is low because of the small degree of regulation. A sales force can be quickly trained in new products with remuneration structured to encourage their sale over traditional products. In the UK sophisticated consumers are most likely to use an IFA in order to obtain advice of good quality and the product which best suits their requirements. This choice will often not be available on the continent. A sales force that distributes innovative products may be the best quality solution.

In emerging markets sales forces may be the only way of developing a distribution channel and the opportunities available are the greatest. Of course, the challenges faced in building a life operation in such a market are far wider than just building the distribution system.

A lack of distribution regulation can be a two-edged sword. Lower compliance costs lead to lower sales force development costs. This allows a greater range of sales force strategies than would be feasible in the UK. This might include part-time, commission-remunerated associates, for example. However, training and control will still be needed for good quality business at a level of production which is worthwhile for the insurer and the associate. Low training and competence requirements also give an increased risk of higher associate turnover, churned business and non-recovery of associate debts.

3.5 Republic of Ireland

The Irish life market shows many similarities to the UK market. A large number of companies are active in both territories. The Irish market is, however far smaller (population 3.6m, of whom 1.3m are employed). Mean premiums per head are around half that of the UK, but still high by EU standards.

The Insurance Act 1989 makes a formal distinction between different type of insurance intermediaries. This is based on the number of agency agreements they have, that is to say, the number of insurers they transact business for:

- Brokers have agency agreements with five or more insurers;
- Agents have agency agreements with between two and four insurers (inclusive);
- Tied Agents have agency agreements with a single insurer.

In these cases an intermediary has a contract with the insurer(s), but is not employed by them. Directly employed sales associates are therefore not classified as insurance intermediaries.

The market shares of each channel are as follows:

Sources of New Life and Pensions Business 1996:

<i>% of Total</i>	<i>Brokers</i>	<i>Agents</i>	<i>Tied Agents</i>	<i>Employees & Co. Reps</i>	<i>Direct Marketing</i>
Annual Premiums	48	3	23	24	2
Single Premiums	61	3	5	25	6

The regulation of insurance sales is primarily voluntary, through the Irish Insurance Federation (IIF). The IIF has introduced a code of practice on life assurance selling among other codes. There is a life remuneration agreement, setting out the maximum rate of commissions which may be paid to intermediaries.

At the time of writing of the paper proposals have been put forward regarding an industry requirement for factfinds. There is also a separate proposal for product disclosure, with a similar level of detail required to UK disclosure. It has been suggested that if disclosure requirements are introduced the existing maximum commissions agreement may be withdrawn.

In December 1996, the IIF introduced a mandatory, industry-wide training and competency test for life assurance salespeople. This required existing sales associates to take the Life Insurance Association Ireland (LIA) Foundation Course by the end of 1997. New entrants to the industry must pass the examination within six months of their appointment. The scope of this examination is generic product knowledge, and as such the impact has not been as great as the introduction of FPC in the United Kingdom.

4. Approaches to Modelling

4.1 Overview

There is relatively little UK actuarial literature regarding the modelling of direct sales forces. This may reflect commercial sensitivities. However, clearly a cost effective distribution mechanism is just as crucial for a life office as accurate product pricing. Actuaries have an important part to play in measuring that performance and within the sales planning process (see for example GN1 4.2). Predicting future sales is also a key element in model office work. Sales force modelling can help in this.

Direct sales associates, if recruited and trained from scratch, will need financial support through their initial period. This makes establishment or expansion of a direct sales force capital intensive. Detailed financial plans can help in assessing the likely return on the capital employed.

The principles of modelling a sales force have been set out, for example by Hall and Sarjant and can be summarised as:

- Associates are modelled as different cohorts of recruits. Within each cohort model points are selected to represent associates of different quality.
- Associates are assumed to have productivity and turnover rates which are a function of their quality and their duration of employment.
- The number of associates in each cohort and their productivity is projected.
- Related expenses are calculated. These can be a function of the associate population, the level of production, or fixed amounts for example.

The validity of the model depends critically on the quality of the assumptions underlying it. This is more of a problem in sales forces modelling than in, say, product pricing. Very few data items are published. Individual company experience may not be wholly relevant for the future because of:

- changes in type of associate recruited;
- changes in product range;
- regulatory change;
- changes in remuneration affecting sales associate behaviour;
- sales force size - if small the data may be of low significance.

Strengths of this 'traditional' model are that the assumptions used are easy to understand and that it models the production of specific groups or individual sales associates. It can produce an all encompassing model of sales force financing and production. This can link to other parts of the model office, for example into projected new business and/or profit and loss accounts.

There are a number of shortfalls with the traditional model though. The size of the model can make it unwieldy. The number of assumptions required is very large and the overall result is highly sensitive to the assumptions chosen. In particular, the choice of sales associate model points is, by its nature, subjective. The model can give reasonable predictions of aggregate production. It can also give reasonable estimates of remuneration costs if these are closely linked to production. However, there is a trend, although not universal, towards a greater proportion of fixed remuneration, with incentives based on achieving certain target levels of production. Use of model points is not well suited to provide insights into the costs of this form of remuneration.

In order to consider ways of improving on this 'traditional' model, the rest of this section considers each of the following areas in turn:

- model size and complexity;
- productivity of sales associates;
- staff turnover.

4.2 Model Size and Complexity

At its simplest, a planning process would use recent sales and expenditure to give baseline targets for future periods. In a stable economic environment this will be just about sufficient for short term monitoring. However, the dynamics of a sales force are complex with many different elements making up a particular outcome. A more complex model will usually be required.

On the other hand, as with other areas of actuarial work, it is important not to over-complicate models. Models to cope with every eventuality are likely to be unwieldy. They may also lead to spurious accuracy, masking the fundamentals of the situation and ultimately distorting the results. It is often better to develop smaller models more appropriate to particular circumstances.

One simplification that is often valuable is to start by modelling only a small part of the sales force such as a branch or team. The small size will not only make the model easier to manipulate and interpret but, perhaps more importantly, to explain to sales force or other management.

4.3 Productivity of Sales Associates

The productivity of individual sales associates is the most fundamental assumption within any sales force model.

Under a pure commission based reward system, sales force remuneration is directly proportional to production. It would not be necessary to consider variations in production between sales associates to project total remuneration costs provided that average production per head were known. However, reward structures are usually more complex than this. The range of productivity must be captured to ensure it links with remuneration.

Four key features of productivity per head become apparent on examination of actual experience:

- Productivity varies widely between sales associates.
- Productivity of an individual rises rapidly during an initial period of training and learning. It then becomes more stable. Depending on the production measure used and the reward structure, production may continue to rise slightly, stay stable, or decline gradually over the longer term.
- Productivity of all associates will be subject to secular changes. These might be external (e.g. consumer demand) or internal (e.g. new product type). This may or may not affect all associates to a similar degree.
- Productivity will be subject to individual variation. The production of an individual will fluctuate from one period to another separately from the above changes. This is effectively a 'random noise' element. Typically such fluctuations will not be sufficient to mask the range of variation of performance.

4.4 How can Production be Measured?

There are many ways to measure production. Traditional measures for new business production are number of policies, new business premiums (often counting single premium business at, say, 10% of premiums) or value of commission. These measures may not reflect the value of the business to the insurer. Therefore maximising production may not be maximising added value. The most useful measure of production is one that is directly proportional to the profitability of the products (or perhaps their profit and expense loadings). This will usually require products to have been recently profit tested on a consistent basis. It is often possible to price the products so that profit is proportional to one of the simple traditional measures.

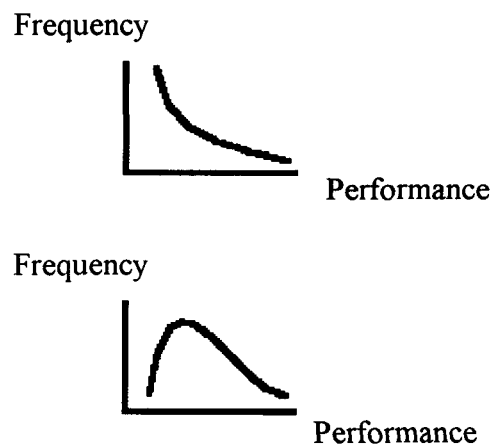
In order to maximise production based on such a measure it has to be simple enough that it can be used as a parameter on which sales force remuneration is based. The sales force must be able to understand the measure if it is to act as an incentive for them to produce the most appropriate new business.

The measure of production can also allow for short-term policy persistency. For example, first year policy lapses can be netted off the new business production. Using such a measure as the basis for sales force incentives can be useful as it emphasises that policies lapsing early add no value.

4.5 Approaches to Modelling Productivity

The critical requirement is that the model should reflect heterogeneity in associate quality and changes in productivity with career duration. Preferably it should do this in a way that reduces the subjectivity of model point selection.

A frequency chart for productivity of a given cohort of associates in an interval of time is likely to take one of two basic forms:



A feature of these distributions is that they can often have fairly fat tails. Performance of the best sales associates may be several times the mean and the mean is significantly larger than the median or mode. In many cases it is prudent not to over-estimate the fatness of tails, so that production is not overestimated. Provided that the mean production per head is not overestimated this is unlikely to be an issue. In some circumstances it can be prudent to assume fat tails. This might happen for example when assessing the cost of introducing an additional incentive payable once production exceeds a certain level. It will be prudent to assume that a high proportion of associates obtain the incentive.

Productivity of a sales associate from a given cohort within a unit interval of time can therefore be represented by a random variable with a distribution similar to the ones above.

There is a theoretical justification for such an approach. Start by assuming that the sale of policies by an associate follows a Poisson process. The Poisson parameter λ is equivalent to the rate of policy sales. A high quality associate would have a high λ , a poorer quality associate a lower λ .

The heterogeneity of associate quality can be introduced by assuming that λ is a random variable. If it is assumed that λ has a gamma distribution, then the number of policies sold per associate in a given interval will follow a negative binomial distribution.

In some circumstances it will be sufficient either to measure productivity by number of policies or assume that all policies are the same size. However, more typically, it will be necessary to consider total sales in terms of premium volume, or some other measure of productivity as discussed above. It can be assumed that the production measure of the policies sold are independent, identically distributed random variables. Then the total production has a compound negative binomial distribution. If the number of events (sales) is reasonably large and the dispersion of the individual events (production measure per policy) is reasonably small a compound negative binomial distribution can be accurately approximated by a gamma distribution.

Hence there is a theoretical justification for assuming that the total productivity of an associate follows a gamma distribution. Appendix A sets out some of the algebra for this argument.

There are five useful features of the gamma distribution that can simplify modelling work.

- **It can take either of the forms depicted**, depending on the parameters chosen.
- **It is closed under addition** - the sum of N independent identically distributed $\Gamma(\alpha, \beta)$ random variables is a $\Gamma(N\alpha, \beta)$ random variable.
- **Its sum tends to the normal** - as $N\alpha$ becomes large, a $\Gamma(N\alpha, \beta)$ random variable tends to the normal distribution.
- **Outperformance can be predicted** - if a random variable X is $\Gamma(\alpha, \beta)$, then the expected value of X where it exceeds some constant v is equal to

$$\alpha/\beta * (1 - G(v)) / (1 - F(v))$$

where $F(x)$ is the $\Gamma(\alpha, \beta)$ cumulative distribution function (c.d.f) and $G(x)$ is the $\Gamma(\alpha+1, \beta)$ c.d.f.. This can be used to calculate the total production in excess of some target limit (useful for example if a bonus or incentive only applies to production in excess of a certain level).

- **Trends can be modelled easily** - for example, to allow for inflation at rate i , if production in one period is $\Gamma(\alpha, \beta)$ in the next period it will be $\Gamma(\alpha, \beta/(1+i))$.

Overall, there are some wider advantages and disadvantages to the distribution fitting approach.

- Sales force productivity can be modelled with far fewer parameters than a model point approach.
- Statistical theory gives well-defined approaches to estimating the distribution parameters and goodness of fit tests to measure objectively how 'accurate' the assumed distribution is.
- Statistical theory and functions can be used to calculate results from the model.

A disadvantage is that the assumption of independent random variables does not allow us to track individual performances or model the degree of dependence between performance of an associate in one sales period and the next.

4.6 Fitting Gamma Distributions in Practice

Following the theoretical approach, the aim is to fit a gamma distribution to the performance of cohorts of associates. The groupings must take into account the data available.

Distribution fitting is not particularly difficult or time consuming - modern spreadsheet packages can generate gamma distributions or statistical software packages can be used. Within a spreadsheet, it is straightforward to use Method of Moments Estimators (MMEs) or Maximum Likelihood Estimators (MLEs) for individual sales data or find the Minimum Chi-square Estimators (MCEs) for censored data. Appendix B gives details of the formulae involved.

The fit of the distribution can be checked using a combination of the following methods:

- graphical comparison of the data and fitted distribution;
- comparison of the moments of the data and the fitted distribution;
- goodness of fit tests: Chi-squared and Kolmogorov-Smirnov statistic.

In practice we have had success in fitting gamma distributions to actual data. Problems can arise where the number of sales is very low, either because the

associates are of low quality or because they are inexperienced. Considering the theoretical derivation this is unsurprising. The number of sales should be reasonably large to use the gamma distribution as an approximation to the compound negative binomial. Also, where the level of sales is very low the data may include associates with zero sales. When faced with this sort of data it is important to be clear about the definition of an associate. Using a different definition of associate within the data may give a better fit.

One adjustment that may be appropriate is to translate the distribution along the x axis, effectively adding a constant to all of the data values. Translation along the x axis is most commonly useful where productivity is uniformly high.

4.7 Staff Turnover

The turnover of sales associates has a significant effect on the financing of sales forces. High performing staff may be enticed to other employers. Other staff may not achieve adequate sales and be managed out or leave as a consequence of inadequate earnings. Replacement of staff may be costly. New associates without industry experience will require intensive training and management. Even associates recruited from other sales forces will require some period of training to familiarise themselves with a new product range and procedures. In either case, there is likely to be a period of financial support. Estimates of such costs vary. It is fairly widely accepted that it currently costs at least £20,000 to take on a new non-industry experienced recruit, and train and support them to a productive level. Some estimates are much higher than this.

So what are the commonly observed features of turnover?

- Turnover is highest within the first year or two of employment, then declines.
- Turnover is different for non-industry recruits than those recruited from other life insurers.
- In the very long term, turnover rates increase, due to mortality and retirement.
- Turnover is lower among associates with high productivity.

4.8 Approaches to Modelling Turnover

The most important features of turnover to note are that turnover is duration dependent and that turnover is higher for associates with low productivity. The

increases in turnover at higher ages are unlikely to be of importance for a model used for short to medium term business strategy.

In the traditional model each model point has its own set of duration-dependent turnover rates. Associates must be grouped by career duration. These groups must be further divided to represent the model points. Turnover rates can then be determined for each model point. The subdivision is a subjective process - the small cells that result can lead to distortions. Projections of sales force size and results are very sensitive to the turnover rates assumed. For example, overestimating the turnover of poor producers and underestimating turnover of good producers could seriously exaggerate the future effectiveness of the sales force.

Assuming productivity at each duration is represented by a statistical distribution (which can change over time), past distributions can be determined from historic data. If these distributions are assumed to apply for future performance then the relationship of turnover to associate quality can be ignored. The productivity distribution derived will automatically allow for the mix of 'good' to 'bad' associates that survive to that duration. The only assumption that has to be determined is the overall turnover rate at each duration.

4.9 Completing the Model

In this section we have considered some specific aspects of sales force modelling. We set out an alternative to a model point approach. Once distributions and turnover rates have been determined, however, the method of building up projected business volumes and costs can continue in the normal way.

In section 5, we discuss how such an approach might be used in practice.

5. Practical Application

5.1 A Simple Scenario

This section examines a simplified practical example of sales force modelling. It has been chosen to demonstrate the processes involved without over complicating the issues. Hence, for example, the number of duration bands used is small. The use of fitted distribution functions is illustrated throughout. In practice, in such a simple case, other methods would also be valid. The data and assumptions used may be indicative of the values that might be appropriate in real life. They will not of course be appropriate in any particular circumstances, nor should they be taken as representing actual experience of any particular company.

The scenario assumed is that an existing insurer already employs a direct sales force. These staff are remunerated purely by initial commission without clawback. It is proposed to expand the number of sales staff and at the same time introduce a new remuneration structure. After preliminary discussion sales management and the actuary agree to investigate a number of possible new remuneration structures. The actuary has been asked to give more detailed advice on each of these.

Under one of the proposed remuneration structures there is a fixed salary element for all staff regardless of duration and a production based incentive. The incentive is only paid on production in excess of a certain sales target. There is also an incentive scheme that provides a fixed cash reward if the sales target has been met.

Throughout the process the actuary will have to liaise closely with sales force and other management. The specific steps the actuary will take to investigate this proposal are to:

- determine the target productivity;
- determine a suitable level of fixed cash reward and bonus payable;
- project the capital costs of the expansion;
- project the likely new business for inclusion in model office work;
- comment on the cost effectiveness of the proposed changes.

For the purpose of this simple case study in-force business has been ignored. In a real case in-force business features such as policy persistency and renewal commissions would have to be considered. Judgement as to the likely effects of the new structure on these factors would be needed.

5.2 Obtaining Data

In the case where there is an existing sales force this can be used as a source of experience. For a start-up operation gathering data is a more difficult process. Suitable sources of data may be:

- commercial marketing organisations (e.g. LIMRA, Datamonitor)
- trade associations (e.g. ABI)
- actuarial consultants
- trade press
- press cuttings services
- HR reward surveys
- industry contacts

In particular, LIMRA publishes fairly frequent surveys giving pooled statistics on associate performance and turnover.

Of course, experience of other organisations may not be a good basis for projections. It can be useful in benchmarking or as a basis for discussion with sales force management regarding their expectations.

The following data will have to be collected:

Current sales force population. The population will be split by career duration. The duration bands should be chosen after an examination of the numbers of associates and their productivity. A reasonable approach may be to start with quarterly bands for recent entrants, with wider bands for greater durations. In the UK associates can only make unaccompanied sales after passing FPC1. To reflect this group an additional 'duration band' might be included. Team supervisors could be treated in a variety of ways depending on their role within the sales force. If they can sell in their own right they could be included as associates (perhaps as a separate cohort). Otherwise they can be treated as an overhead expense proportional to the number of associates. Higher management is likely to be best dealt with as an overhead expense.

Associate Productivity. Data will be required to fit productivity curves for each duration band. A measure of production, as discussed in section 4.4, should be used. Ideally the production of each individual associate should be available but grouped data can also be used. Productivity is an assumption which may be particularly sensitive to changes in circumstances, whether internal or external. An understanding of salient events within the sales force and market is required to judge how far past experience is an accurate reflection of the current position and the extent to which future changes may affect this. Any change in the remuneration package will always have some

effect on productivity. Indeed this is probably a key objective in changing remuneration terms. The data should be examined to decide whether new recruits with prior industry experience should be modelled with different productivity to inexperienced recruits.

Associate turnover rates. Rates dependent on associate duration are determined. If there is an additional duration band to represent the pre-FPC1 category then a transition probability out of this category is also needed.

Policy persistency rates. These must be determined if some recovery occurs on early policy lapses. If different policy types are aggregated together then the persistency rates should be weighted to reflect the volume of the different policy types sold and any differences in the level of recovery applying.

Overheads and other expenses. Data on all field expenses is required. This can be analysed into a simple formula such as a percentage of remuneration, percentage of production, fixed amount per associate or fixed amount per new recruit (which would include explicit costs such as external training). Product pricing will include allowances for new business acquisition and ongoing servicing costs (among others). It is helpful to break down product pricing acquisition cost allowances into head office (e.g. marketing and compliance department costs) and field office elements.

5.3 The Key Financial Constraint

The actuary should always bear in mind that the key financial constraint for the insurer is that the sales force costs should be no greater than those in product loadings (assuming of course that business has been recently profit tested). The field structure must be set up with this in mind. In a period of rapid expansion it is unreasonable to expect the constraint to be met initially but a viable long term position should be sought. The capital subsidy required can be calculated and compared with the value added to the insurer by the sales force to calculate the return on capital employed. In some instances this approach is formalised by setting up the sales force as a separate subsidiary. A profit and loss result for the sales force can be projected. This treatment can clarify the real cost effectiveness of the salesforce.

5.4 Determining the Target Productivity

This can be determined either by looking directly at the historic productivity of associates and/or at the fitted distributions. The target level will be chosen so

that a certain proportion of associates ought to meet the target, possibly refining this by splitting the associates by duration. The effect of changing the remuneration package on productivity must be considered. Judgement and close liaison with the sales force management will be necessary in these circumstances.

If the fitted distributions are used then the procedure is as follows. Suppose that the following gamma distributions have been found to apply to the quarterly productivity of different duration associates.

<i>Associate Duration</i>	<i>Mean Production</i>	<i>Alpha Parameter</i>	<i>Beta Parameter</i>
Up to 6 months	4000	0.5333	0.000133
7 to 12 months	7000	1.2250	0.000175
13 or more months	10000	2.0000	0.000200

After discussion with management it is decided to fix the target level so that around 40% of associates with over 1 year's experience can be expected to meet it, based on current productivity. The target can then be set by looking at the relevant percentiles of the distributions. The 60th percentile of the 13+ month distribution is £10,112. Hence a target level of £10,000 per quarter could be chosen.

From this the proportion of staff in other duration bands who will achieve the target can also be readily predicted:

- in the up to 6 months category, £10,000 per quarter corresponds to the 89th percentile. 11% of this group would achieve the target.
- in the 7 to 12 months category, £10,000 per quarter corresponds to the 76th percentile. 24% of this group would achieve the target.

5.5 Determining the production incentive and fixed cash reward

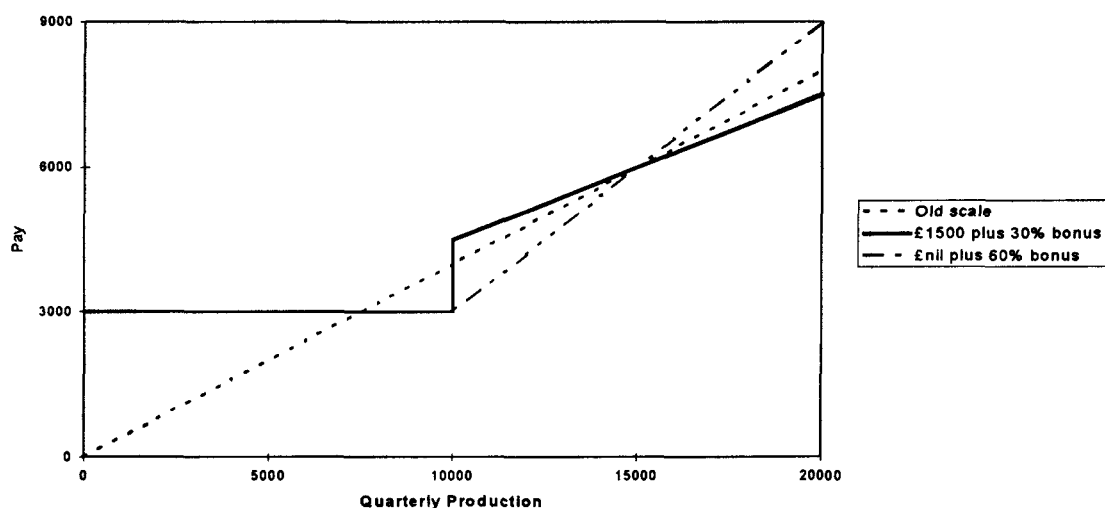
This can be thought of as a problem of meeting the following constraints.

- The production incentive and cash reward must be sufficiently large to act as an incentive for the associate to maximise his production.
- The total level of income for associates must compare reasonably with what they might earn from a competitor insurer, other sales organisation or wider alternative employment.
- Associates who produce above target must produce business cost effectively for the insurer.

- The amount of earnings for associates at different productivity levels has an acceptable degree of consistency with the previous remuneration package.
- The total cost of the remuneration package must fall within the portion of sales force budget available to meet this.

The relative importance of these constraints and their quantitative effects will depend on circumstance. The amount of cash reward might well be heavily influenced by the views of sales force management and/or market practice rather than by a detailed mathematical treatment.

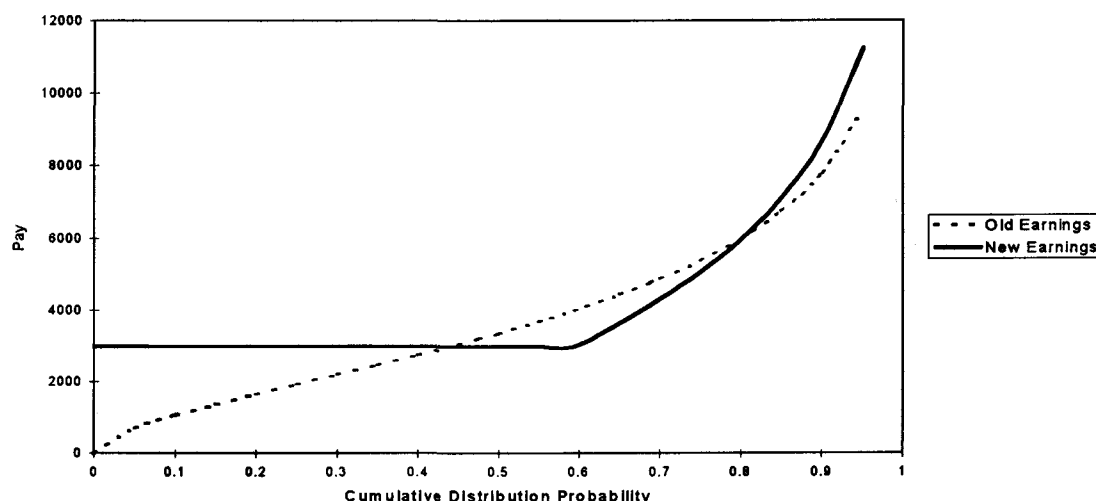
The graph below shows how earnings of an experienced associate would vary according to his production on the old and new remuneration scales with varying levels of incentive.



The graph compares two possible new structures with the existing commission scale. With no fixed cash bonus, but a large proportionate bonus, poor performing staff (below around £7,000 production per quarter) and good performers (above £15,000) will benefit. Other staff will be disadvantaged. However, this structure might still be considered since it does provide a more generous marginal rate of incentive for mid-range staff. With a fixed cash bonus, and a lower proportionate bonus, different groups of individuals would be advantaged or disadvantaged. Some mid-range performers would be advantaged. On the other hand, the very best performers would be disadvantaged, which could be seen as sending out an unacceptable message to the sales staff.

As it stands, the analysis shows the impact on staff with different levels of production. This can be misleading, since it does not indicate the proportion of staff achieving each level. An advantage of fitted distributions is that they can

also be readily used to look at the distribution of earnings. The graph below plots associate earnings against the percentile point of the distribution. The example plots the nil cash bonus plus 60% of excess production scale against existing commission earnings. From this graph it can be seen that the bottom 44% of producers would increase earnings if these terms were introduced. The top 20% of producers would also see an increase in income. The 36% of mid-range producers would be worse off. This type of information is very valuable in discussing the possible impact of new reward scales.



Altering the remuneration package will affect production and sensitivity tests will be required - see 5.8.

5.6 Projecting the Number of Associates

With the existing sales force size and sales associate turnover rates it is very simple to work out the level of recruitment needed to expand the sales force at the desired rate.

Rapid expansion of a sales force may result in a less stringent selection procedure being applied. In turn this may lead to more recruits dropping out before the end of training or at early durations. If this is expected turnover rates could be adjusted, or at least the sensitivity should be investigated as part of the modelling.

5.7 Projecting the Capital Cost of the Expansion

Capital cost projections can be made using the modelled values for associate numbers, remuneration and expenses. To calculate the total amount of incentive paid it is necessary to use the result (given in 4.5) about the expected value of a gamma distributed variable over a limit.

5.8 Projecting the Likely New Business Production

This is a function of the number of associates within each duration band and their associated productivity. However the proposed changes may result in changes to associate productivity. For example, rapid expansion may lead to less stringent selection resulting in lower productivity for future recruits.

The change in the remuneration package is likely to have some effect on the productivity distribution. In the case study the introduction of the salary and incentive system might lead to the following changes.

- An increase in the number of very low producers. In practice measures would be introduced to weed these out at a very early stage.
- An increase in the number of producers just above the target level.
- A possible decrease in the number of very high producers if their earnings decrease with the move away from a commission only package.

The possible effect of these could be allowed for by prudent adjustment to the parameters of the productivity distribution curve.

5.9 The Cost Effectiveness of the Proposed Changes

This can be examined by examining a statistic such as the ratio of total sales force cost to field acquisition expense allowances. This value can be compared between the old and new structures. This approach is certainly a good starting point.

For the example case, which requires new capital, a more strategic analysis must also be performed. The outputs from the sales force model can be used to produce projections of achieved profits and/or appraisal values at future points in time. The return on capital employed can then be analysed.

6. Concluding Comments

Within this paper we have considered direct sales forces from an actuarial viewpoint. Direct sales forces have been significant distributors of life assurance, and this looks set to continue. Greater competitive pressures will increase the need for sound financial management.

We have put forward some alternative techniques for modelling of sales associate performance. These arise from our unease about the application of model points in this context. Model points are suitable for a task such as modelling policies within a model office. Policy data is likely to be large volume. Stochastic variation is not very significant. Taking averages across a block of policies should to give a fair reflection how those policies will behave as a whole. This relies on a fair degree of 'smoothness' in the way policies behave. Cashflows from policies of the same duration and age of life assured are usually either a fixed amount per policy or proportional to the size of the policy.

With sales associates, model points may not work as well. There will be less data to analyse. Statistical modelling can make the most of data by parsimonious use of parameters, and a rigorous framework in which to determine and test the distributions fitted. Smaller data volumes may make stochastic variation more important. Consideration of variances and limit distributions can be useful. The cashflows arising may not be adequately described by averages. For example a salary plus bonus structure will result in mean pay higher than that for the mean production. It is our belief that a distribution based approach can offer a useful way forward.

Bibliography

Bowers N.L., Gerber H.U. et al. (1986), *Risk Theory*, Society of Actuaries, reprinted by Institute and Faculty of Actuaries, London

Datamonitor (1996), *Direct Salesforces and Tied Agents 1996*, Datamonitor, London

Easton A.E. et al. (1990), *Designing a Field Compensation Structure*, Record 16(2), Society of Actuaries

Education & Examination Committee of the Society of Actuaries (1993), *Marketing for Actuaries*, LIMRA, Hartford

Financial Times Management Reports (1994), *The Marketing and Distribution of European Insurance*, Pearson Professional, London

Hall R.J., Sarjant S.J. (1992), *The Financial Management of a Life Assurance Sales Operation*, Presentation to Staple Inn Actuarial Society

Heath, R.B. & Stern, L.N. (1997), *Are You Getting What You Pay For?*, Society of Actuaries Product Development News Issue 44

Hogg R.V., Klugman S.A. (1984), *Loss Distributions*, Wiley, New York

Hossack I.B., Pollard J.H., Zehnwirth B. (1983), *Introductory Statistics with Applications in General Insurance*, Cambridge University Press, Cambridge

Jaffe J.M. et al. (1986), *Evaluating Financial Aspects of Different Distribution Systems*, Record 12(3), Society of Actuaries

Kipling, M.R. (1995), *The Effect of Regulatory Changes on the Distribution of Life Assurance in the United Kingdom*, 5th AFIR Colloquium Proceedings Vol. II

LIMRA International and LOMA (1991), *Techniques for Measuring Agency Profitability*, LIMRA International and LOMA, Hartford and Atlanta

LIMRA Research Unit (1996), *Annual Retention and Production, Year 1995, UK and Republic of Ireland*, LIMRA Europe, Watford

LIMRA Research Unit (1996), *Census of Life Insurance Sales Personnel 1995*, LIMRA Europe, Watford

LIMRA Research Unit (1995), *Compensation Handbook, Sales Associates 1995*, LIMRA Europe, Watford

LIMRA Research Unit (1997), *Field Sales Personnel Inventory, Fourth Quarter 1996, UK and Republic of Ireland*, LIMRA Europe, Watford

Lindgren, B.W. (1976), *Statistical Theory*, Collier Macmillan, New York

Linton, M.A. (1924), *Returns under Agency Contracts*, Record of the American Institute of Actuaries XIII (1)

Mc Conney E.M., Guest R.C. (1943), *Some Basic Principles and Mathematical Tables Related to Agents' Compensation*, Transactions of the Actuarial Society of America XLIII

MINTEL Marketing Intelligence, (1996), *Direct Salesforces*, Mintel International, London

Moorhead E.J. (1963), *Valuation of Nonvested Renewal Commissions*, Society of Actuaries Transactions XV

Stontz C.J. et al. (1990), *Designing a Field Compensation Structure*, Record, Society of Actuaries 16(3)

Wellborn J.M. (1994) *The Changing Compensation System of Agents*. Journal of the American Society of CLU and ChFC, May 1994.

Appendix A

A Theoretical Justification For Fitting Productivity Distributions

If a series of events meets the following three criteria it is a Poisson process.

- For a small interval of time the probability of an event occurring is proportional to that length of time and the proportionality factor (equivalent to the rate of events) remains constant in time.
- The probability of multiple events occurring at one moment in time is zero.
- The number of events in non-overlapping intervals is independent.

For a sales process the rate of sale does change slowly with time (as the associate gains in experience). However, by looking at an associate's productivity in relatively short duration bands (such as quarterly) the rate of sale should be expected to be fairly stable within the time interval.

If a policy sale is considered to be an event then multiple events occur when an associate sells more than one policy to an individual or group of individuals at a single point in time. However, these will generally be rare and we can define an event as being the sale of one or more policies at a single time. The distribution (or average) of sizes of an event will then need to be adjusted to allow for multiple sales being made.

The number of events in non-overlapping intervals is distorted in real life by seasonality factors and possibly by the remuneration package itself. However, if spread out over a period such as a year they are independent.

It seems reasonable to consider that the sales process is a Poisson process. Define this by saying that in an interval of time $(0,t]$ the number of sales for associate i is $n_i(t)$ where $n_i(t)$ has a Poisson (λ_i, t) distribution.

The heterogeneity of associate quality can be reflected by letting λ_i be a random variable. The versatility of the gamma distribution makes it a good model for the distribution of λ_i . For example, it is commonly used in non-life insurance to represent claim frequency on a heterogeneous portfolio.

If X has a Poisson (λ) distribution and λ has a $\Gamma(\alpha, \beta)$ distribution then:

$$\begin{aligned} f(x|\lambda) &= \frac{\lambda^x \cdot e^{-\lambda}}{x!} \\ \Rightarrow f(x) &= \int_0^{\text{Inf}} \frac{\lambda^x \cdot e^{-\lambda}}{x!} \cdot \frac{\beta^\alpha \cdot \lambda^{\alpha-1} \cdot e^{-\beta\lambda}}{\Gamma(\alpha)} d\lambda \end{aligned}$$

Recognising that the term inside the integral is similar to a $\Gamma(\alpha+x, \beta+1)$ p.d.f. it is easy to obtain:

$$f(x) = \frac{\Gamma(\alpha+x)}{\Gamma(\alpha) \cdot x!} \cdot p^\alpha \cdot (1-p)^x$$

This is a generalised form of the negative binomial distribution (if α is an integer it is the negative binomial distribution).

Therefore the number of sales made by a randomly selected associate in a period follow a negative binomial distribution with parameters:

$$\begin{aligned} k &= \alpha \\ p &= \beta/(1-\beta) \end{aligned}$$

In certain circumstances it would be worthwhile fitting the negative binomial distribution and using number of sales as part of the model.

For an individual associate the total production in a unit time period, P , has a compound negative binomial distribution.

$$P = X_1 + X_2 + \dots + X_n$$

where Random variable X_i is the size of each sale
 n is a negative binomial random variable representing the number of policies sold

It is reasonable to assume that the X_i are independent and identically distributed although it is not necessary to assume a specific distribution for them.

Manipulating the compound negative binomial distribution is complex. However, the gamma distribution can be used as a reasonable approximation to it, especially when the number of events is reasonably large and the distribution of the individual events has relatively small dispersion. A simple justification of this is given in Bowers, Gerber et al., expanding the moment generating function of the compound distribution.

Therefore a gamma distribution can be used to model productivity and will work best when number of sales per associate in any period is reasonably large and the dispersion of policy sizes is low. In practice, the requirement for the number of sales to be large can be a constraint on the usefulness of the model. If the number of sales is very low, (such as for a very poor quality sales force or very recent recruits) the gamma distribution may not give a satisfactory fit.

Appendix B

Fitting Gamma Distributions and Testing Their Goodness of Fit

B.1 Introduction

This Appendix aims to give practical guidance on some ways of fitting gamma distributions using a spreadsheet. The process is not difficult.

The probability density function for a $\Gamma(\alpha, \beta)$ distribution is:

$$f(x) = \beta^\alpha \cdot x^{\alpha-1} \cdot \frac{e^{-\beta \cdot x}}{\Gamma(\alpha)}$$

Where $\Gamma(\alpha)$ is the gamma function.

In Excel the functions GAMMADIST and GAMMAINV provide all that is required. Note however that in Excel the parameter β used is the reciprocal of the one above.

Distribution fitting software is also commercially available. One advantage is that distributions other than gamma can also be easily examined. If such distributions are found to give a better fit to a certain set of data they can of course be used.

B.2 Parameter Estimators

Fitting the distribution involves finding estimators for the two parameters. Two types of estimators are suitable when the data is given for individual associates; Method of Moment Estimators or Maximum Likelihood Estimators. If the data is censored (grouped in bands) then Minimum Chi-square Estimators can be calculated.

Method of Moment Estimators are calculated by equating the first and second moments of the distribution and the sample data.

If the data consists of points x_1, \dots, x_n representing the production of n associates in an interval of time then the i 'th moment of the data points is defined as:

$$E[X^i] = \sum_{j=1}^n \frac{x_j^i}{n} = m_i \text{ say}$$

The mean and variance of the $\Gamma(\alpha, \beta)$ distribution are:

$$\begin{aligned}\text{Mean} &= \alpha / \beta \\ \text{Variance} &= \alpha / \beta^2\end{aligned}$$

Hence the estimators for the parameters are:

$$\begin{aligned}\alpha &= \frac{m_1^2}{m_2 - m_1^2} \\ \beta &= \frac{m_1}{m_2 - m_1^2}\end{aligned}$$

Fitting Maximum Likelihood Estimators involves more complex theory.

Define:

$$L(\alpha, \beta) = \prod_{j=1}^n f(x_j; \alpha, \beta)$$

Which is the likelihood of obtaining the set of data points x_j given that the gamma distribution has parameters α and β . The values of α and β which maximise this function for the set of data points are to be found.

Then:

$$L(\alpha, \beta) = \prod_{j=1}^n \beta^\alpha \cdot x_j^{\alpha-1} \frac{e^{-\beta \cdot x_j}}{\Gamma(\alpha)}$$

Taking logarithms and rearranging:

$$\log L(\alpha, \beta) = \alpha \cdot n \cdot \log \beta - n \cdot \log[\Gamma(\alpha)] + (\alpha-1) \cdot \sum_{j=1}^n \log x_j - \beta \cdot \sum_{j=1}^n x_j$$

Taking partial derivatives in order to attempt to maximise:

$$\frac{\delta \log L(\alpha, \beta)}{\delta \alpha} = n \cdot \log \beta - \frac{\delta}{\delta \alpha} \cdot n \cdot \log[\Gamma(\alpha)] + \sum_{j=1}^n \log x_j$$

$$\frac{\delta \log L(\alpha, \beta)}{\delta \beta} = \frac{\alpha \cdot n}{\beta} - \sum_{j=1}^n x_j$$

Setting the second of these to zero implies that:

$$\frac{\alpha}{\beta} = \frac{1}{n} \cdot \sum_{j=1}^n x_j$$

which gives the ratio between α and β .

Unfortunately, the partial derivative with respect to α can not be expressed algebraically and a numerical method has to be used. (In fact this function is available in statistical tables as an alternative approach.) The maximising values of α and β will be reasonably close to the Method of Moment Estimators. Substituting for β and graphing around the MME of α will determine the maximising values to whatever level of accuracy is required.

Note that the constraint on the ratio of the MLE's for α and β results in the mean of the MLE fitted distribution having the same mean as the data sample. This is an attractive feature for the model.

If the gamma function is translated along the x axis by x_0 then the probability density function is:

$$f(x) = \beta^\alpha \cdot (x - x_0)^{\alpha-1} \cdot \frac{e^{-\beta \cdot (x - x_0)}}{\Gamma(\alpha)}$$

In this case three parameters have to be found, α , β and x_0 . The Method of Moment Estimators are found by looking at the first three moments of the data and are:

$$\begin{aligned} \alpha &= 4 \cdot (\text{Var}(X))^3 / [E(X - E(X))^3]^2 \\ \beta &= 2 \cdot \text{Var}(X) / E(X - E(X))^3 \\ x_0 &= E(X) - 2 \cdot (\text{Var}(X))^2 / E(X - E(X))^3 \end{aligned}$$

Again, calculation of Maximum Likelihood Estimators involves numerical methods. A simple approach is to use the MME for x_0 as calculated above, then substitute for $x - x_0$ and find the MLE's for α and β as for the non-translated case.

If the data is censored (grouped into contiguous bands) then Minimum Chi-square Estimators can be fitted. Let k be the number of data bands, f_i the frequency of data points falling within the i 'th band and n the total number of data points. Then let p_i be $F(c_i) - F(c_{i-1})$ where F is the $\Gamma(\alpha, \beta)$ c.d.f. and c_i is the upper bound of the i 'th band. Then the Minimum Chi-square Estimators are the values of α and β which minimise:

$$\sum_{i=1}^k \frac{(f_i - n.p_i)^2}{n.p_i}$$

The values of α and β that minimise this sum can be found using a numerical method or a spreadsheet 'solver' function for example .

B.3 Testing the Goodness of Fit

The quickest and simplest way to start is to look graphically at the data and fitted distribution and to compare their moments. If these look promising more scientific methods can be used.

Pearson's goodness of fit statistic is equal to the sum used for finding MCEs in section B.2. For large n it has an approximately chi-squared distribution with $k-1$ degrees of freedom.

The Kolmogorov-Smirnov statistic is equal to the maximum difference over the n data points in the fitted distribution's c.d.f. and the c.d.f. obtained directly from the data points. The lower the statistic the better the fit. The statistic has been tabulated or can be approximated for reasonably large n .

Hogg and Klugman contains more detail and many practical examples of these goodness of fit tests.