RESERVING FOR

OUTWARDS

REINSURANCE

Presented to GISG 1993

on Hinckley Island

CONTENTS

Working Party Members

Colin Czapiewski
Philip Archer-Lock
Peter Clark
Catherine Cresswell
David Hindley
Stuart Shepley

1. INTRODUCTION AND SUMMARY

1.1. Of all the areas of non-life insurance, probably the one that is worst understood by practitioners (including actuaries) is reinsurance.

1.2. Despite the progress made by actuaries in the last 20 years, no paper has been written that explains how we should approach the tricky topic of reserving for outwards reinsurance. Nor does one really explain the various complexities and attributes of reinsurance.

1.3. This paper briefly explains the practical aspects of reinsurance and then goes on to suggest methods of tackling the estimation of the ultimate claims position. Normally, there is not **one** correct or even most accurate method that should be used, in view of the many factors that may have an impact on the reinsurance recoverables.

1.4. Reinsurance covers both property and casualty (liability) business. Some reinsurance is specifically related to individual risks, whereas some cannot be so assigned and instead relates to a book of business. Some reinsurance is proportional, when the reinsurer follows the fortunes of the reinsured (eg quota share, surplus), whereas some is non-proportional and the reinsured then retains an agreed limited amount before the reinsurance comes into play (eg excess loss, stop loss). The position of the reinsurer is then geared up and so his business is more volatile than the underlying business, sometimes substantially so.

1.5. In explaining reinsurance, examples and graphical representations are most helpful - one picture is worth a thousand words - and both have been used in this paper.

1.6. Any jargon has (hopefully) been kept to a minimum. Explanations have been given where appropriate.

1.7. Section 2 gives a brief introduction to aspects of reinsurance and goes on to describe some more complex areas. The difficult subject of variable covers (such as top and drops, cascades, etc .....) is touched on, but for the sake of brevity it is not described in too much detail. Topical subjects, such as franchise and warranty covers, are also mentioned.

1.8. Section 3 describes approaches to reinsurance reserving. The different methods are explained and are viewed from a practical perspective. There are discussions about the benefits and drawbacks of the various methods.

1.9. Section 4 describes practical considerations and difficulties that are often encountered when faced with a real life situation.

1.10. Section 5 shows some other features to be considered in this area. Some aspects of reinsurance can so easily be overlooked or ignored, **at the actuary's peril**.

2. OUTWARDS REINSURANCE PROGRAMMES

2.1. A collection of individual reinsurances may be purchased to help protect the inwards book of business and improve a poor gross result. This resultant reinsurance programme may have a considerable financial effect on a gross loss passing through to its net position. Premiums will be paid outwards to purchase this protection, and payments will be received after inwards losses are incurred, in accordance with the policy wording. If no losses occur, or fewer than expected, then the purchaser will lose out financially. If the value of gross losses exceeds the expected amount, then the purchaser may gain financially - if they are the correct sort of loss.

If the incorrect reinsurance is purchased, then it will fail to respond to the gross losses, and then even in a year where the gross position is poor, the net will not be improved.

2.2. Some reinsurance may be very wide-ranging in the losses that are covered, whilst others are very specific indeed. In a Marine protection programme, there may be "Rig Specific" protections which "inure" to the benefit of the main "Excess of Loss" reinsurance programme. This means that recoveries are made from these "Rig" reinsurers initially, and if they are large losses then recoveries are made from the main reinsurance protections or "Generals". Similarly, an individual risk loss (say arising from a commercial fire) may result in recoveries from the risk excess programme, and if this does not have sufficient cover then the "Generals" may come into play.

2.3. An insurance company or Lloyd's Syndicate may have any of the following types of reinsurance (although the list is by no means exhaustive) covering a section of its inwards business

(i) Quota Share Treaty - usually on a book of business, where the reinsurer receives a proportional premium for a proportional share of the risk (although some ceding commission for expenses is withheld, plus possibly some profit commission arrangement).

(ii) Surplus Treaty - similar to Quota Share except that individual risks usually have a proportion ceded which varies according to specific characteristics of the risk.

(iii) Facultative - excess loss cover on an individual risk, often for a particular reason because this is expensive to administer compared with reinsurance under a Treaty.

(iv) Risk (or Per Risk) Excess of Loss Treaty - responds to losses arising from one individual inwards risk (normally). It may sometimes be written

as covering losses from one event from one cedant, or from one event from one reinsurance programme from one cedant.

(v) General Excess of Loss Treaty - responds to losses arising from one event, but from an aggregation of losses from many risks. For instance, losses arising from Hurricane Andrew, or the European storms of 1990, or the big 1994 Californian Earthquake.

There are many complications arising in these reinsurances that will be covered later in this paper.

2.4. Proportional Treaties are often given insufficient attention when reinsurance is being discussed. The main reason for using this type of reinsurance is where it is wished to write a larger line on a risk than is prudent given considerations of: capital, excess loss reinsurance protections, the balance of the portfolio of inwards business, or various other reasons. The first two examples in 2.3 above are proportional Treaties (quota share, surplus).

Premium and claims amounts can be directly attributed to specific individual risks, and normally the reinsurer "follows the fortunes" of the reinsured. Following this one step further, the experience of the outwards reinsurance will tend to bear a strong resemblance to the appearance of the relevant inwards business - especially for Quota Share. This may not always be the case for Surplus Treaties where the cessions made to that Treaty may result in a better or worse experience. Also, the Surplus Treaty may only be used for larger risks, and the experience of these may differ from that for smaller risks.

Once the reserving for the relevant inwards business has been performed, the proportional reinsurance can follow a similar pattern. It may be suitable to directly pro rate the proportion reinsurance (see Section 3).

2.5. Generally, the proportional treaties are easier than non-proportional business for an observer to understand. Portfolio premiums and claims can complicate procedures, but given a concise description of a proportional Treaty, no substantial undue complications should arise.

2.6. There is far less facultative reinsurance around now than there used to be 10 or more years ago. The cost of dealing with this business, and the inherent delays in agreeing reinsurance for just one risk, inhibit common usage in the current more commercial climate.

Reinsurance premiums and claims can easily be reconciled with the inwards risks.

The facultative reinsurance must be considered in relation to the experience and expectations of the inwards risks, and hence a more individual approach may be the only one for these reinsurances.

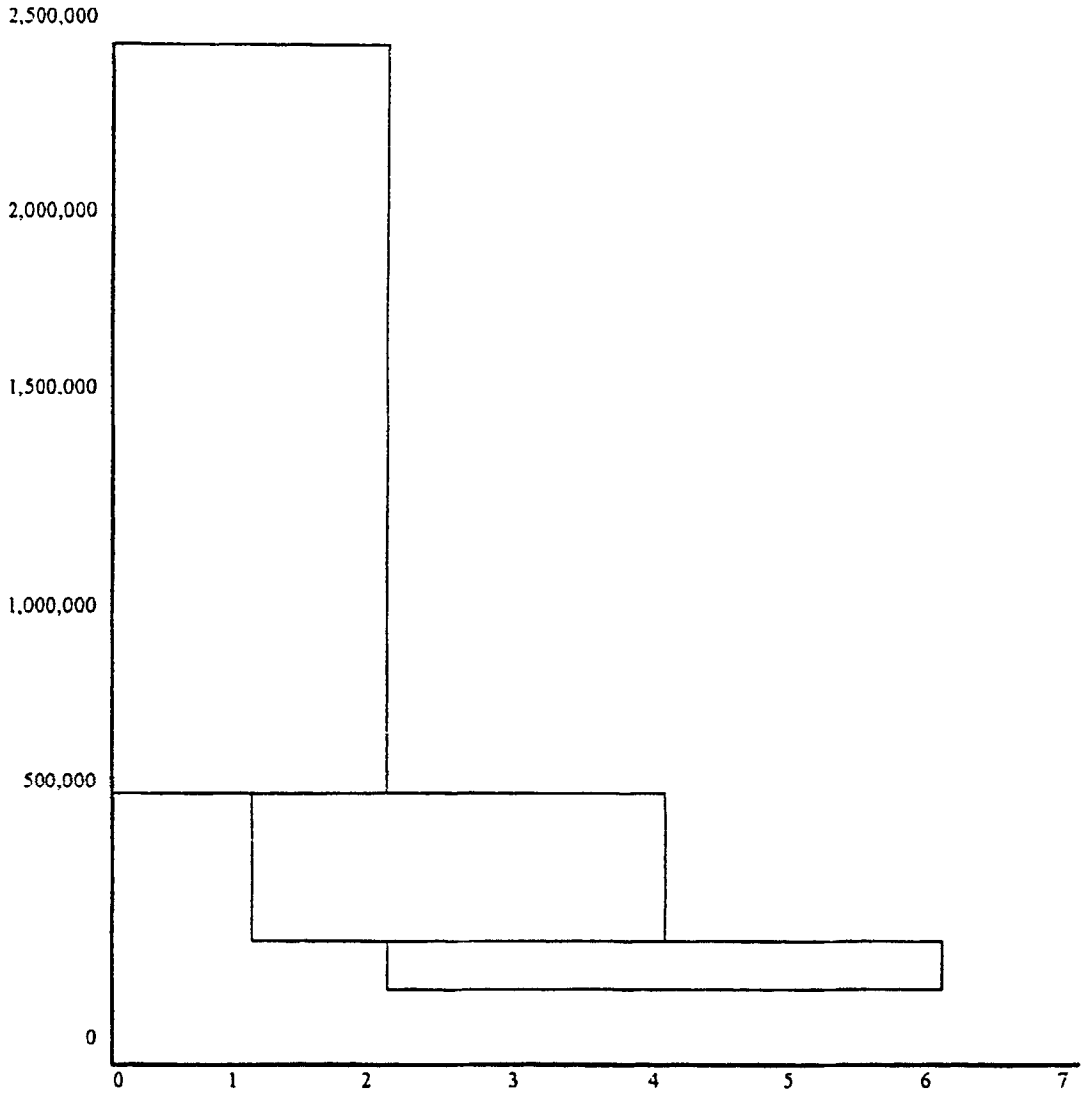
2.7. The remaining reinsurances are excess of loss treaties. Reserving methodologies are covered in Section 3 of this paper, and the remainder of this section will discuss some of the niceties and complexities of such reinsurance.

2.8. One company may have several excess of loss programmes. Property Risk X/L's may be used to protect losses from larger individual risks, General Property X/L's for catastrophes, Casualty X/L's for losses from long tail business, Personal Accident X/L's, and also perhaps some Aggregate X/L's (stop loss) to cover some specific classes of business, such as hail.

2.9. The chance of a large loss occurring is normally less than the chance of a smaller one occurring, and a large loss will also generate recoveries from the lower layers. So excess of loss programmes will normally have protection against **more** losses from the lower layers and **fewer** losses from the higher layers. The general shape of an excess of loss programme will be like this:

COMPANY XYZ

	Cover		**Retention**	**Aggregate deductible**	**Reinstatements**
Layer A	£100,000	xs	£100,000	£200,000	3
Layer B	£300,000	xs	£200,000	£300,000	2
Layer C	£500,000	xs	£500,000	£0	1
Layer D	£1,500,000	xs	£1,000,000	£0	1



The vertical axis shows the size of the loss, and the horizontal axis the number of losses.

The graphical representation of a reinsurance programme is so helpful in understanding its workings and it also highlights deficiencies. When preparing or examining a new programme, the time spent in the preparation of such a chart is well worth while.

2.10. Other aspects of X/L programmes must be understood, including the inevitable jargon:

(i) The layer includes the **Cover** (sometimes called the sum assured) and the **Retention** (also known as the excess).

If a loss to Company XYZ is £150,000, then £100,000 will be retained by XYZ and £50,000 will be claimed from the reinsurers of Layer A.

If the loss is £750,000, then the retention will be £100,000, with a total (total loss) to Layer A of £100,000, a total to Layer B of £300,000 and a partial (loss) to Layer C of £250,000.

And, oh dear, if a loss of £3,000,000 occurs, then £100,000 will be retained, £100,000 to Layer A, £300,000 to Layer B, £500,000 to Layer C, £1,500,000 to Layer D, and **another** £500,000 retained by XYZ. The loss has gone through the top of the reinsurance programme!

(ii) The **Rate on Line** (ROL) is the premium divided by the cover expressed as a percentage.

For instance in Layer B above, if the premium is £45,000 for the £300,000 excess £200,000, then the ROL is 15%, or 15.

(iii) The **Aggregate Deductible** is also called a sideways retention. For Layer A, recoveries of £100,000 excess of £100,000 are only permitted after two totals (or the equivalent in partial losses to this layer) have been suffered. Two losses of £100,000 excess £100,000 make up the aggregate deductible of £200,000. For Layer B, one total loss to the layer (or £300,000 of partial losses excess of £200,000) is retained.

(iv) When a loss occurs to a Layer, the policy may require a **Reinstatement Premium** to be paid so that if a further loss occurs, the reinsurance may pay over again, to a maximum of the defined number of reinstatements. The reinstatement premium is usually 100% of the "up-front" premium for property business, and may be free for casualty (ie it is deemed to be included in the "up-front" initial premium), although other bases are used. If a partial loss occurs, (say £50,000 excess £100,000 for Layer A) then only a corresponding proportion of the reinstatement premium is paid (ie 50%).

Layer A is known as 1 + 3, Layer B as 1 + 2 and Layers C and D as 1 + 1.

(v) There are two rather different situations when a layer may not be fully placed.

It is in the interests of the reinsurer that the reinsured has some incentive to manage the claim prudently. A mandatory **Coreinsurance** of, say, 10% means that for Layer A above, a loss of £200,000 will result in the reinsurer retaining the initial £100,000 retention, plus 10% of the Layer

£100,000 xs £100,000 (or £10,000), so the total retained by XYZ would be £110,000 and the recovery will be £90,000. This coreinsurance is also a method of diluting the losses within a spiral.

In times of capacity shortage (such as the current time), some layers may have **Placement Shortfalls** where the brokers simply cannot place all the reinsurance in the market. Again, Layer A may end up with a 10% coreinsurance plus a further 15% placement shortfall, leaving just 75% placed. So a total loss to Layer A would result in the reinsured retaining £125,000 (£100,000 + £10,000 + £15,000) and receiving £75,000 from his reinsurers.

Other more complex aspects of X/L reinsurance will emerge in the remainder of this section. They are not necessary for a broad understanding of Section 3 but will be very useful in gaining an understanding of modern reinsurance practice.

2.11. Variable Covers

2.11.1 Variable covers may appear in many guises, such as Top and Drops, Middle and Drops, Cascades, Stepdowns and Shortfalls. Essentially, they are contracts which are originally defined to sit in one place within a reinsurance programme, but may be used, if required, in some other place according to predetermined rules. They are an example of contracts where the nomenclature is not consistent throughout the market. It is therefore important to study the contract wording, or discuss with the underwriter precisely how they may be used. Indeed, in some cases the cover notes may not detail exactly how the cover may be used, but rather this is determined by the agreed intention or current market practice at the time the contract was written. (Just imagine the potential legal implications of this.)

2.11.2 Top and Drops, Middle and Drops and Cascades refer to covers which sit at the top or part way up a reinsurance programme to cover losses vertically, but if the fixed (ie. non-variable) part of the programme is exhausted horizontally then they can drop to cover this horizontal exhaustion provided it occurs above the predetermined drop limit. They are often very flexible contracts and may allow whole or parts of reinstatements of cover to fall to various places in the programme. However, the total amount of cover given to any one particular loss is normally limited to one reinstatement of the contract. This is demonstrated in example 1 below.

2.11.3 Example 1

Claim Details

Loss	Date of loss	Ultimate $000s
A	12.1.89	1,800
B	23.3.89	700
C	30.3.89	2,200
D	10.7.89	2,900
E	8.10.89	3,500
F	1.12.89	1,700

Reinsurance Programme

All covers are for 12 months incepting 1.1.89

Cover	Retention	Aggregate Deductible	Drop Limit	Reinstatements
$000s	$000s	$000s	$000s	
400	100	400		5
500	500	0		3
1,000	1,000	0		2
1,000	2,000	0		1
1,000	3,000	0	1,000	1

Example 1 figure 1 at the end of this section shows the reinsurance programme before allocation to the claims. The Top and Drop sits excess of $3 million, but may drop to any point excess of $1 million.

Figures 2 and 3 show the result of applying the claims to the fixed programme before application of the Top and Drop. There is horizontal exhaustion of the fixed programme as detailed in the table below.

Layer	Loss	Breakout Before Applying Top & Drop	Breakout After Applying Top & Drop
$000s		$000s	$000s
500 x 500	E	200	200
	F	500	500
1000 x 1000	E	800	0
	F	700	0
1000 x 2000	E	100	0
1000 x 3000	E	500	400

The position after applying the Top and Drop is shown in Figures 4 and 5 Several features should be noted:

- The breakout below $1 million cannot be covered by the Top and Drop because it is below its drop limit
- The Top and Drop can be used in more than one layer of the programme at the same time.
- A maximum of one full reinstatement of the Top and Drop can be used on a particular loss. Thus, despite there being $300,000 Top and Drop unused, this cannot be used to cover any more of the breakout on loss E in the layer $1m x $3m.

2.11.4 Step Downs operate in a similar way to Top and Drops, but are more limited in their action. Normally they sit on top of other variable covers and may be used to fill a gap in the reinsurance programme caused by dropping these other variable covers. The contract may also specify that only full reinstatements may step down to the vacated layer.

2.11.5 Shortfalls introduce further complexity. These may, or may not, have all the features of a Top and Drop. However, they may also be able to be used to fill out partially placed layers, but **not** any coreinsurance on the layer. Thus, for example, a layer might carry 10% coreinsurance, possibly due to standard market practice, but only be 70% ceded because the underwriter had not been able to place the other 20%. If there was a shortfall policy covering this layer then it could be used to fill out the remaining unplaced 20%.

2.11.6 There may be several variable covers in a reinsurance programme. In this case, it is possible that more than one cover may be able to provide protection for a loss in a particular layer. There may be predetermined priorities which apply to the covers, indicating which contracts inure to the benefit of the others. These may then be used to decide in which order the covers should apply. However, there may be cases where the underwriter has some discretion on the order in which they are used. Especially where different covers have different inception dates or drop limits, it may be important to apply them in the most efficient way allowed.

2.12. Franchises and Warranties

2.12.1 Usually, whether a contract can provide cover for a loss in a particular account is determined by the period of cover and the layer covered by the contract. However, certain contracts are further restricted to cover only losses which satisfy some other criterion. Examples of this are contracts which carry Franchises or Warranties, which impose additional tests on the size of a loss before a recovery can be made.

2.12.2 Here again, nomenclature is not always standard throughout the market. However, a common usage of these terms is as follows. Normally, Franchises relate to the size of the loss to the particular reinsured company. For example, a layer of $1m x $2m carrying a $3m Franchise would only cover losses to the company where the inward claim reached $3m. Thus, in this case, it can be seen that the layer will either provide a full $1m cover to a loss if it reaches $3m, or nothing for a loss below $3m. Hence, each loss either gets a full $1m reinstatement of cover or no cover at all. This may also be known as a **"Trigger"**

2.12.3 On the other hand, Warranties relate to the original market loss, that is the size of the direct insured loss rather than the inward loss to the particular reinsured company. For this reason, they are often referred to as Whole Market Franchises or Market Loss Franchises. These are particularly common in aviation business, where, for example, a loss would only be covered if the original market loss exceeded, say, $50m. Warranties might also apply to particular parts of a loss, for example, an aviation contract might carry a "hull plus $50m warranty". To trigger this contract the original market loss excluding the hull part of the claim would have to exceed $50m. Normally this would mean the liability part of the claim had to exceed $50m, unless more than one aircraft hull were involved, in which case the claim excluding the largest hull would need to exceed $50m.

2.12.4 If the original market loss arising from a particular incident is close to the Warranty limit, then this can make the task of deciding whether the cover applies particularly difficult. For example, the US Air claim in 1989 had an original market loss of just over $50m and so recoveries were made on $50m warranty contracts. However, the original market loss subsequently fell below $50m, and the refunds had to be paid on the contracts where recoveries had been made. It is quite possible that further settlements of the original loss, for example relating to fees, could push the original market loss above $50m again, causing the situation to revert to the former position. Clearly this will have a large effect on the gross inward development of the loss if a company writes a substantial amount of business which carries the Warranty.

2.13. Basis for Allocation of Cover

2.13.1 An excess of loss reinsurance layer may have many losses which reach the layer. Although the potential availability of a cover for use on a loss is usually determined by whether the date of loss falls between the inception and expiry dates of the cover, in other words a losses occurring during (LOD) basis, determining which of a sequence of losses will receive cover is often more complex.

2.13.2 In the Non-Marine and Aviation markets, losses are usually allocated cover on a date of loss (DoL) basis. In this case, the cover is allocated to the first loss which occurs. Any remaining cover is then allocated to the second loss to occur, and so on.

2.13.3 By contrast, in the Marine market cover is allocated on a date of settlement (DoS) basis. In this case, the outward reinsurance cover is allocated to losses as their gross inward paid position reaches the level of cover. Thus the losses which first require the cover on a paid basis will receive the recoveries.

2.13.4 The following example illustrates these two methods of allocation, and also shows that the basis of allocation can affect the final net position.

Claim Details

		Paid as at		Ultimate
	Date of loss	**31.12.91**	**31.12.92**	
A	12.2.90	1,200	2,500	3,200
B	6.5.90	400	800	1,400
C	31.10.90	1,000	3,100	3,400

Reinsurance Programme

Inception Date	Expiry Cover Date	Retention		Reinstatements
1.1.90	31.12.90	1,000	1,000	1
1.1.90	31.12.90	1,500	2,000	1
1.6.89	31.5.90	1,000	3,500 drop to 1,000	0

Example 2 figure 1 at the end of this section shows the reinsurance contracts before allocation to the claims. The Top and Drop was not renewed in 1990, and no other covers are in force during the year.

Figures 2 and 3 show the result of applying the reinsurance programme to the ultimate claims on a date of loss basis. The 1,000 x 1,000 layer is exhausted horizontally, causing loss C to break out by 400. As the Top and Drop has expired before loss C occurs, it cannot be used to cover this exhaustion. The total net claims are therefore 3,400, comprising 1,000 retention on each loss and the 400 horizontal exhaustion.

Figures 4 and 5 show the result of applying the reinsurance programme on a date of settlement basis. In this case, loss B breaks out of the 1,000 x 1,000 layer as the other two losses use the layer before it does. As loss B occurred within the period of cover of the Top and Drop, the horizontal breakout is covered by the Top and Drop. Therefore the only net claim is the retention of 1,000 on each loss.

2.13.5 In practice, the situation may be very much more complex than this example, but similar features may occur. This may be important if the reinsurance contract does not state explicitly the basis for allocation, or if the market is not operating strictly in accordance with the specified basis.

2.13.6 For example, although the covers in the aviation market should usually be applied on a date of loss basis, the market may actually apply them on a date of settlement basis as it is easier to administer. Considerable work might be involved to unbundle all the payments so that recoveries are made on a date of loss basis. Companies in the market might decide that the costs involved would be too great to justify the reallocation. However, there may be cases where the financial impact would be significant.

2.13.7 In the marine market the complication may arise more from the point of view of the calculation of reserves, as the date of settlement basis

specified in the contracts is likely to be used in practice. If reserving is being done by projecting individual gross claims and applying the outward reinsurance programme, it may be necessary to estimate not only the size of the ultimate claim but also the timing of settlements relative to the other claims.

2.13.8 The basis for allocation of cover may also affect the development of the gross inward claims.

2.13.9 For example, consider an account where most inward contracts have two reinstatements. Suppose the market suffers four similar major losses. If the contracts are applied on a date of loss basis then the first three losses which occur may exhaust most of the inward contracts, leaving only a relatively limited recoverable exposure to the fourth loss. If the fourth loss were to settle more quickly than the others, this limit on the inward exposure may not be apparent from the development of the paid claim. Only when the other losses develop beyond certain limits will the development of the fourth loss slow down, and even decrease if the market unbundles to a date of loss basis. Thus, projections based on development to date without consideration of inward exposures may be misleading.

2.13.10 If, on the other hand, the contracts apply on a date of settlement basis, then parts of each contract may be used on each loss depending on their relative settlement rates. The exposure may therefore be spread more evenly over all four losses than was the case for the date of loss basis. The ultimate profile of the four losses may therefore be quite different under the two bases of allocation.

2.14 Umbrella Covers

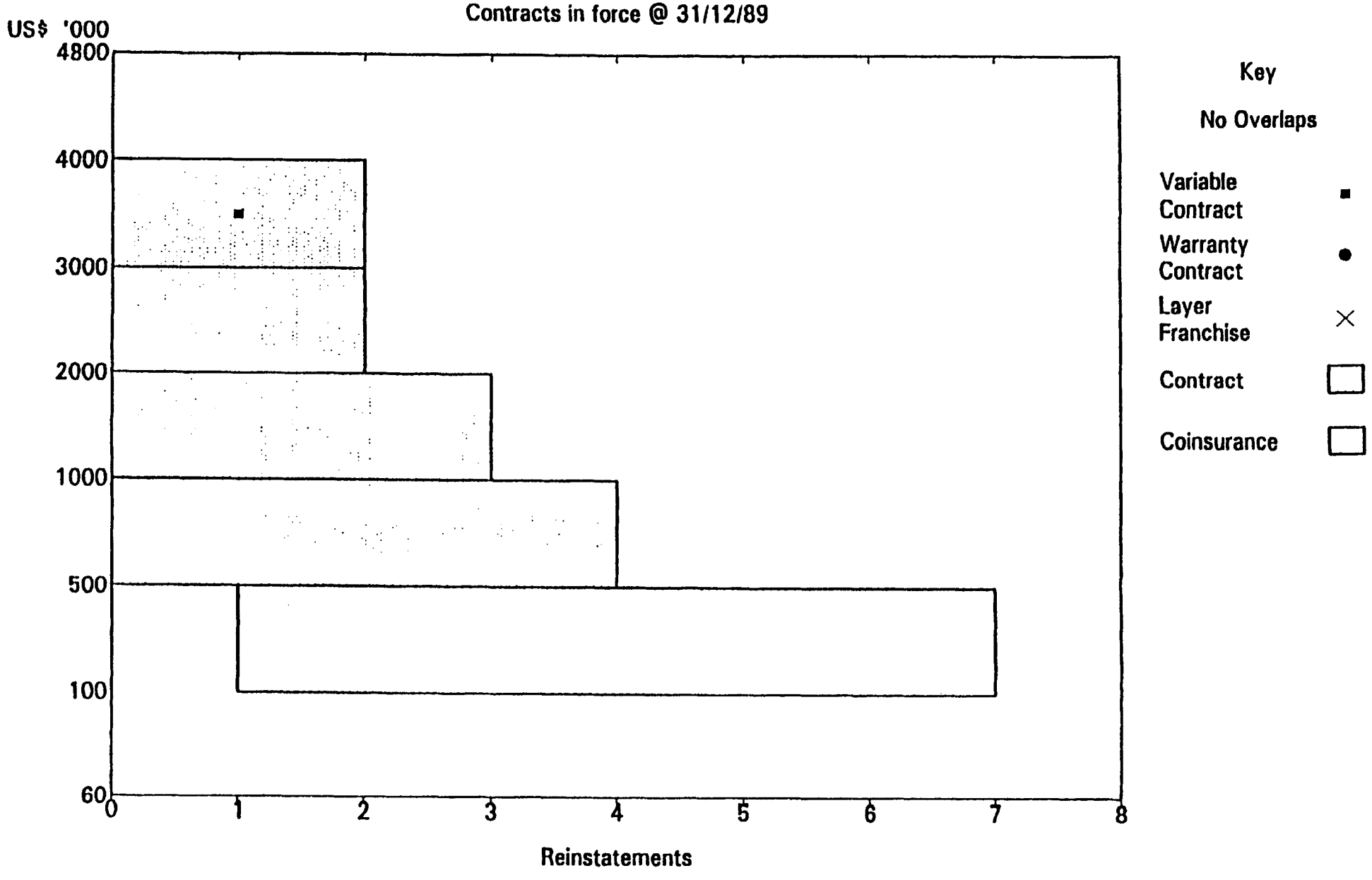
2.14.1 As with the variable covers detailed above, some reinsurance protections are not specifically deemed to respond to an exact specific loss but can react differently depending on particular circumstances.

2.14.2 An umbrella cover is a catch-all type of protection. Examples may include Non-Marine main account losses excess of $40m **plus** retrocession account losses excess of $10m. Alternatively, it may cover, say, Marine excess of $80m **plus** Aviation excess of $20m **plus** Non-Marine excess of $50m.

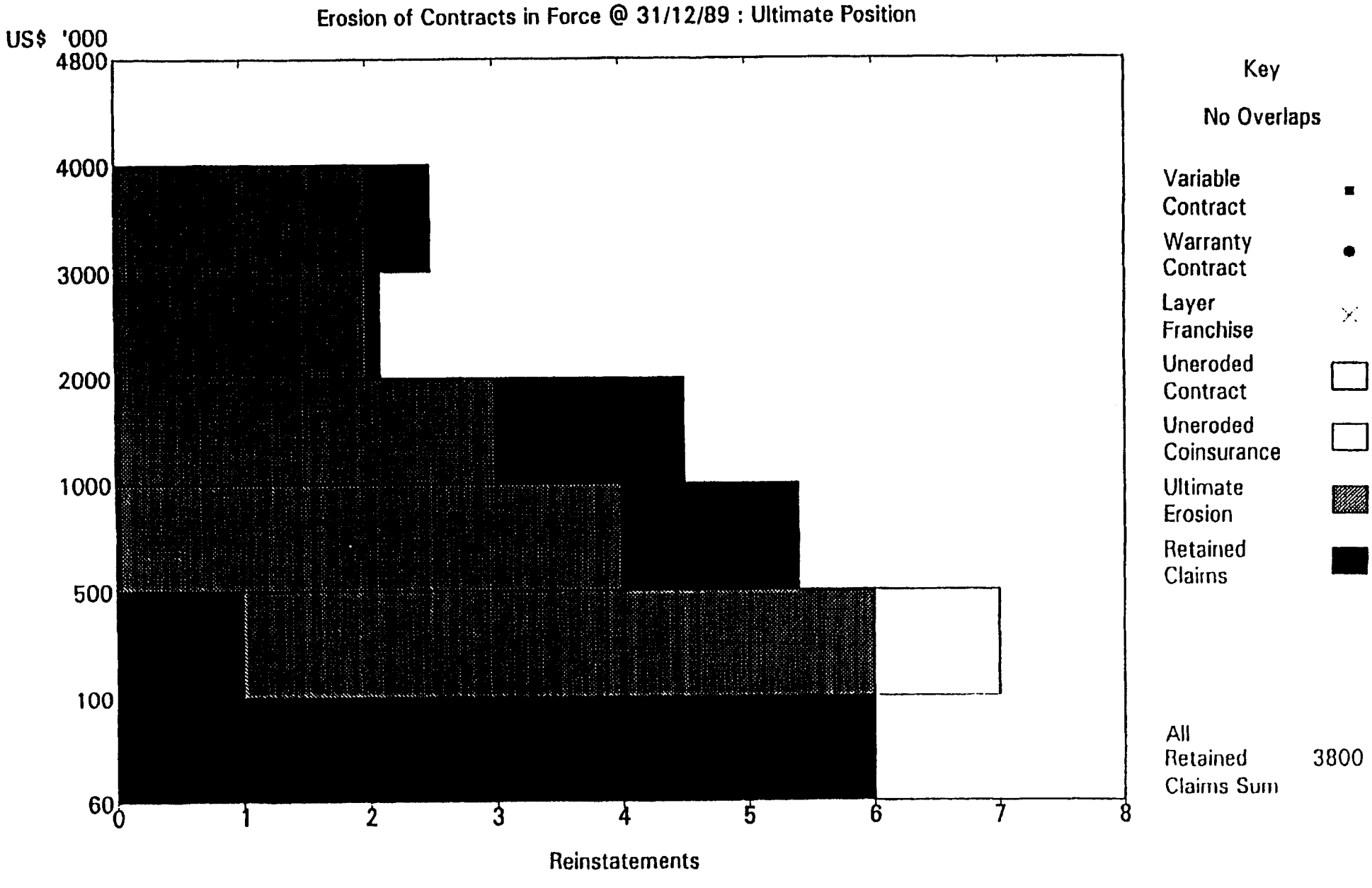
2.14.3 The mechanics of these reinsurances are not difficult once the contracts are understood. The difficulty arises in their interaction when losses arise from the different underlying reinsurances.

Example 1 - Top and Drops

Figure 1



Example 1 - Before Top and Drops
Figure 2



Example 1 - Before Top and Drops
Figure 3

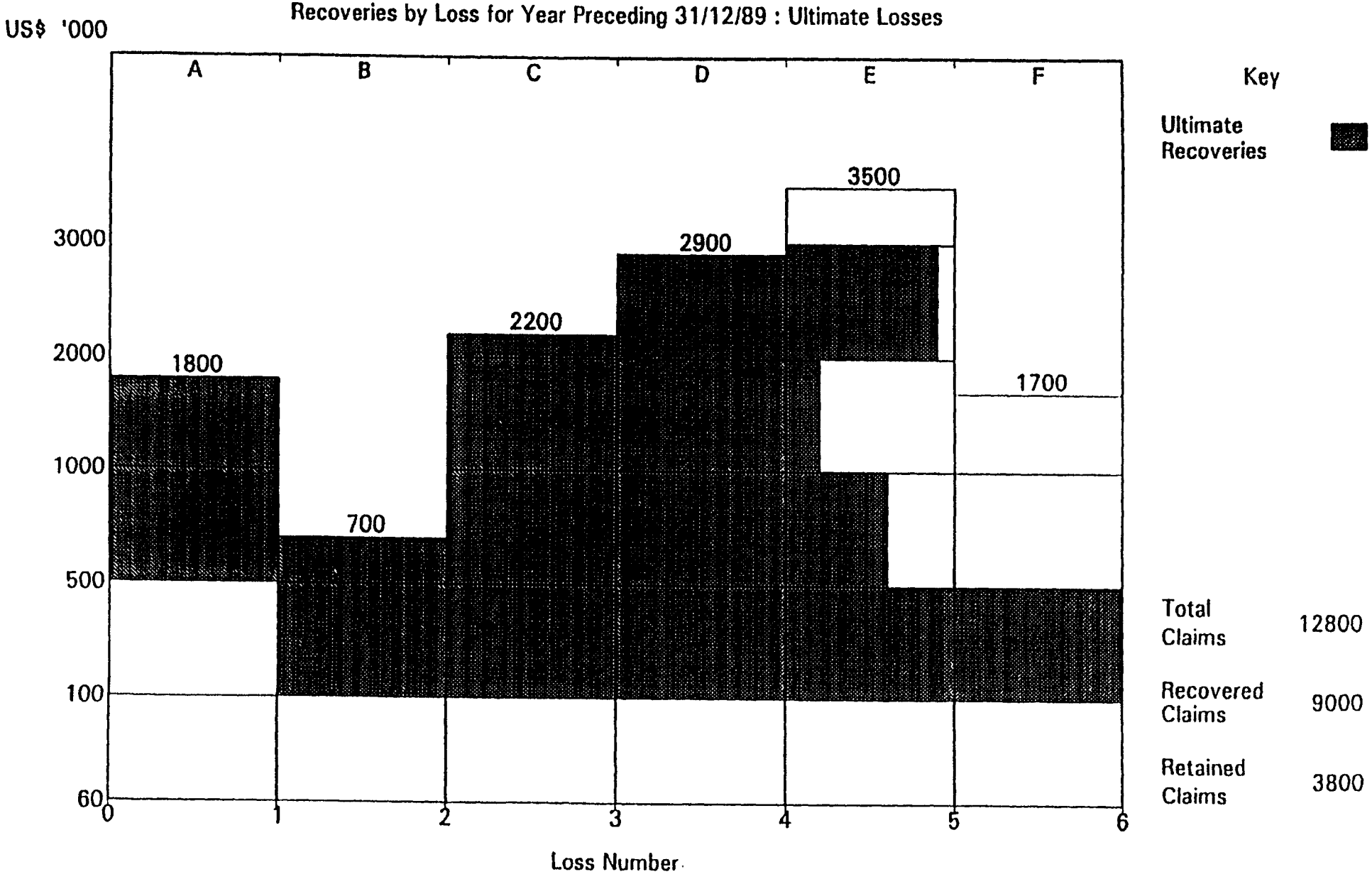
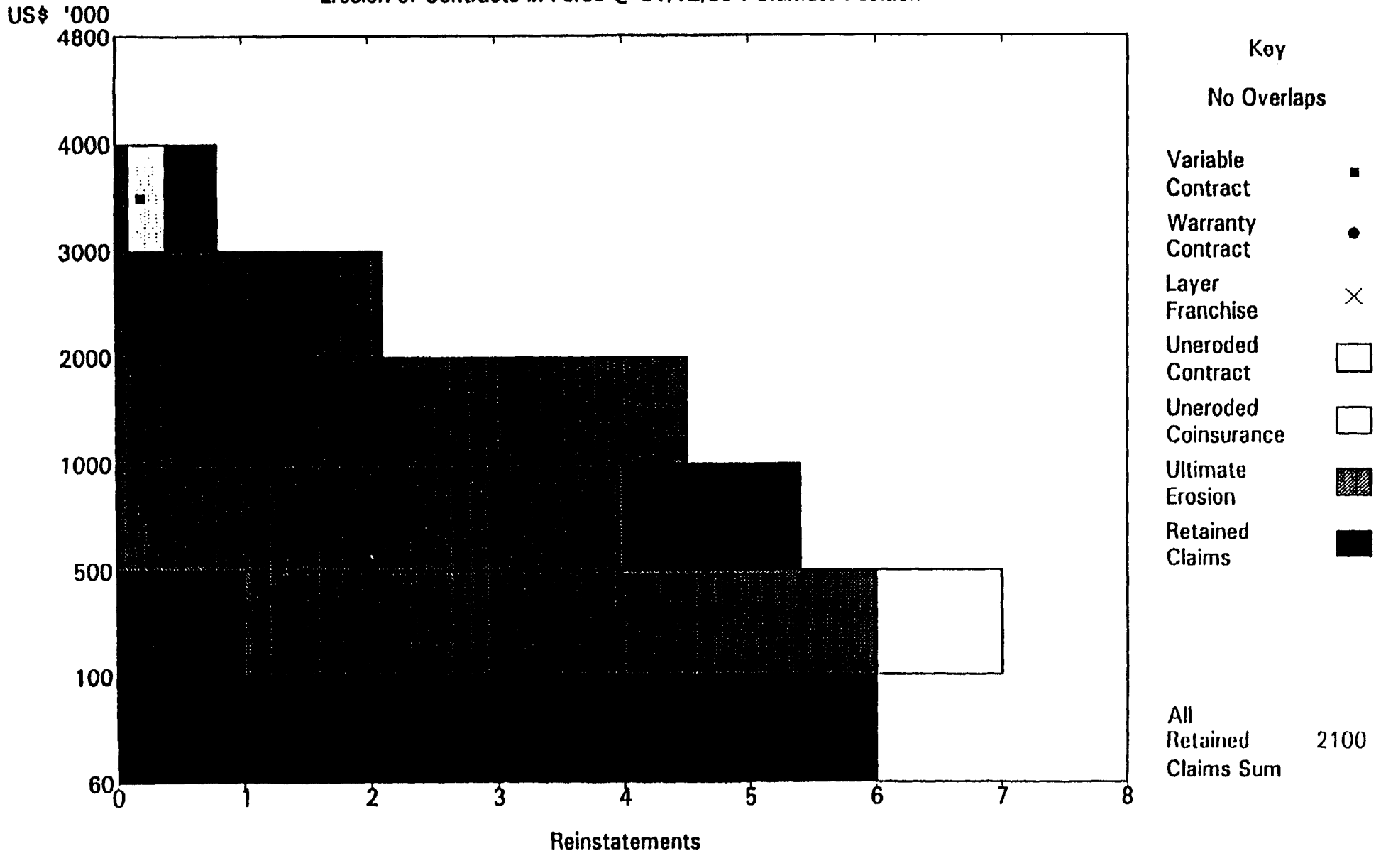
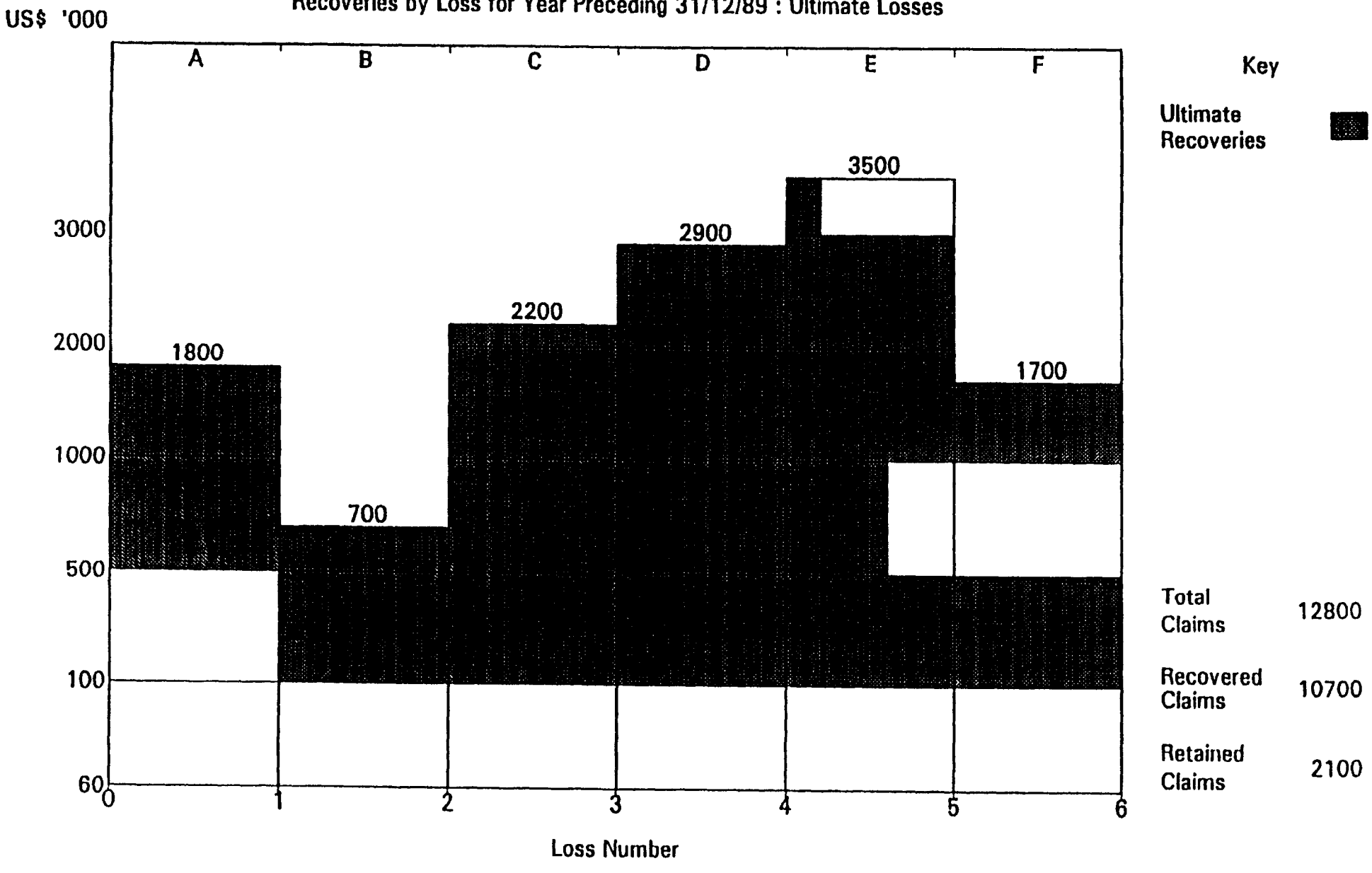


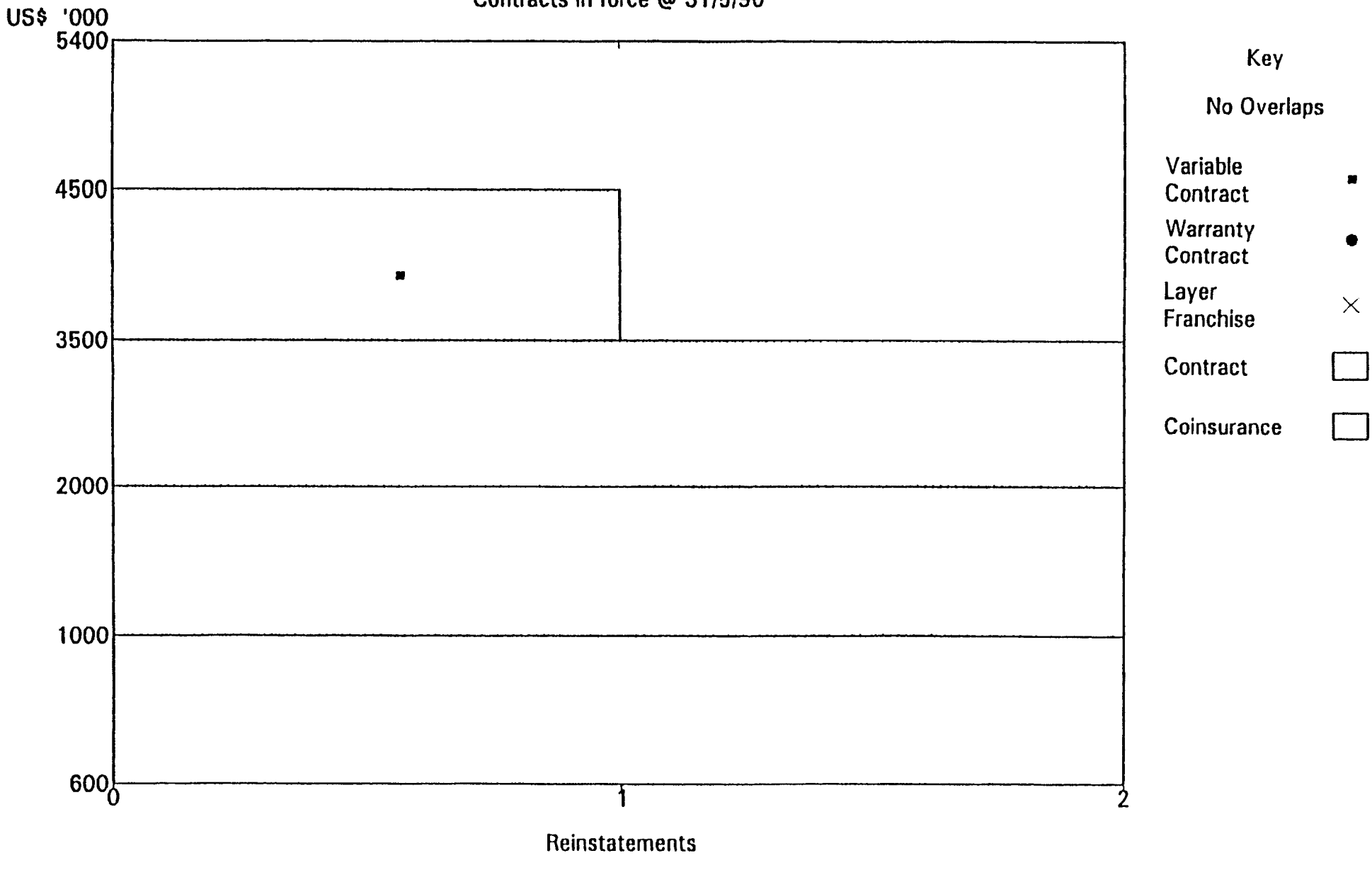
FIGURE 4
Example 1 - Top and Drops



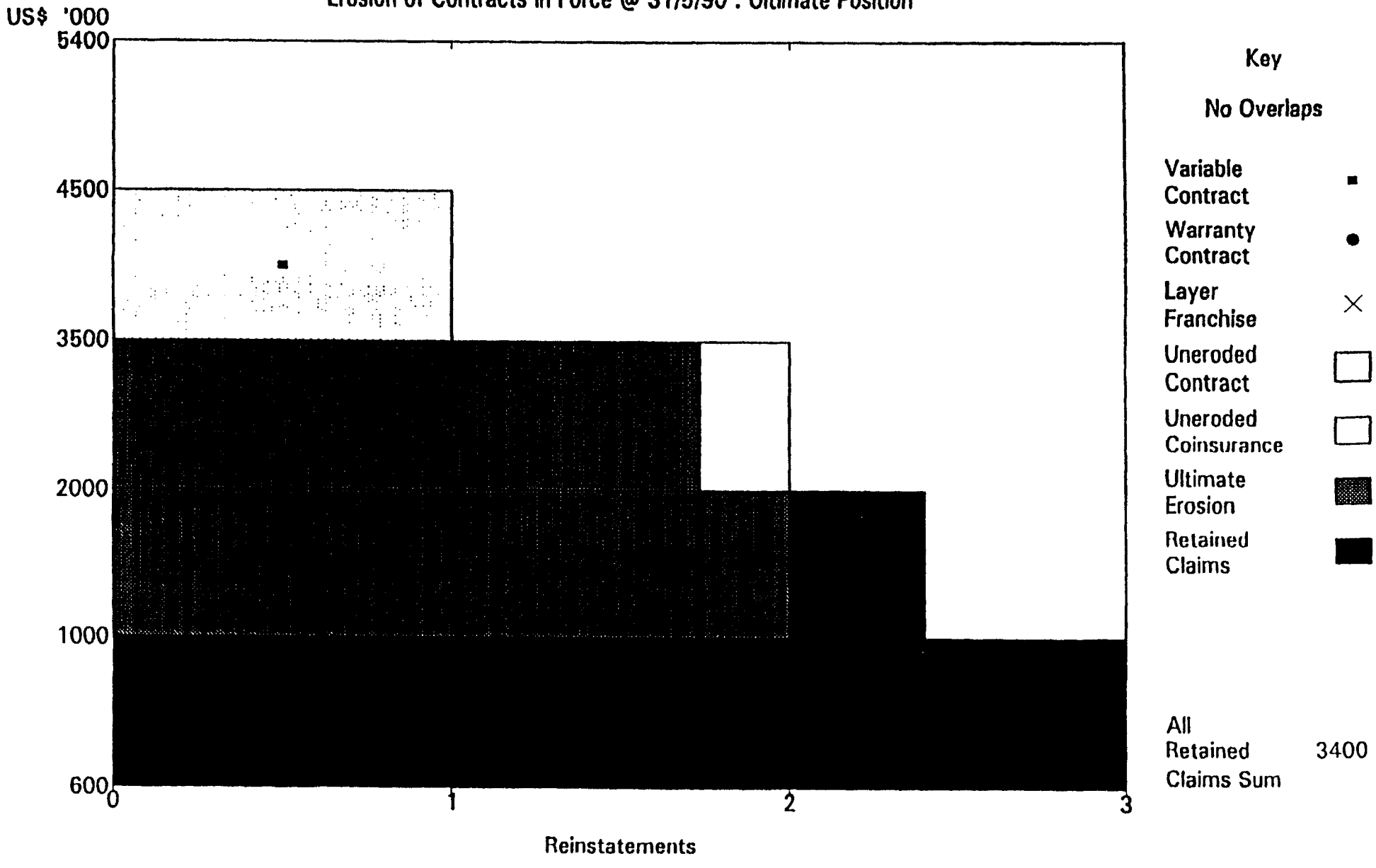
Example 1 - Top and Drops
Figure 5



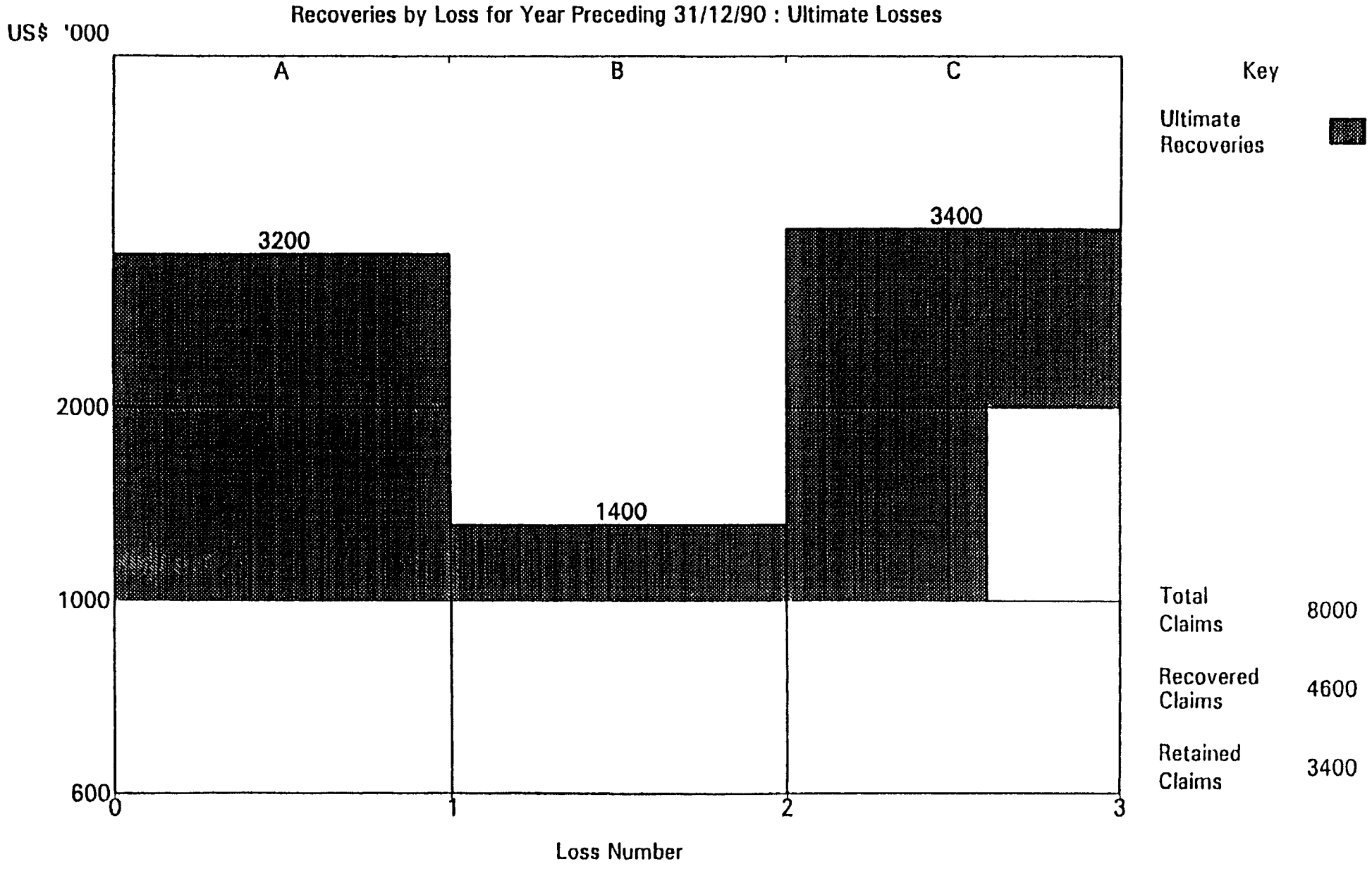
Example 2 - Basis of Allocation
Figure 1



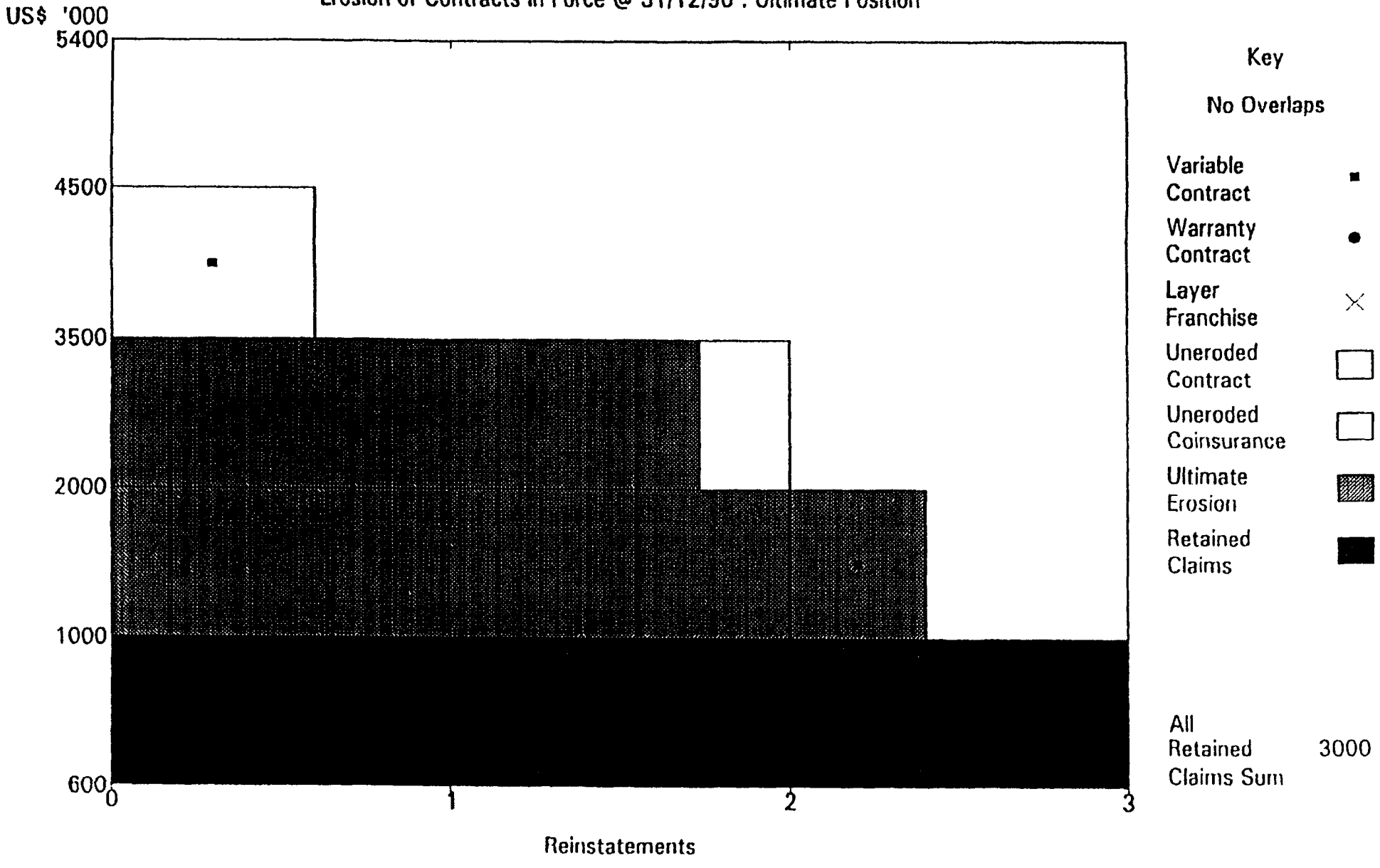
Example 2 - Date of Loss Basis
Figure 2



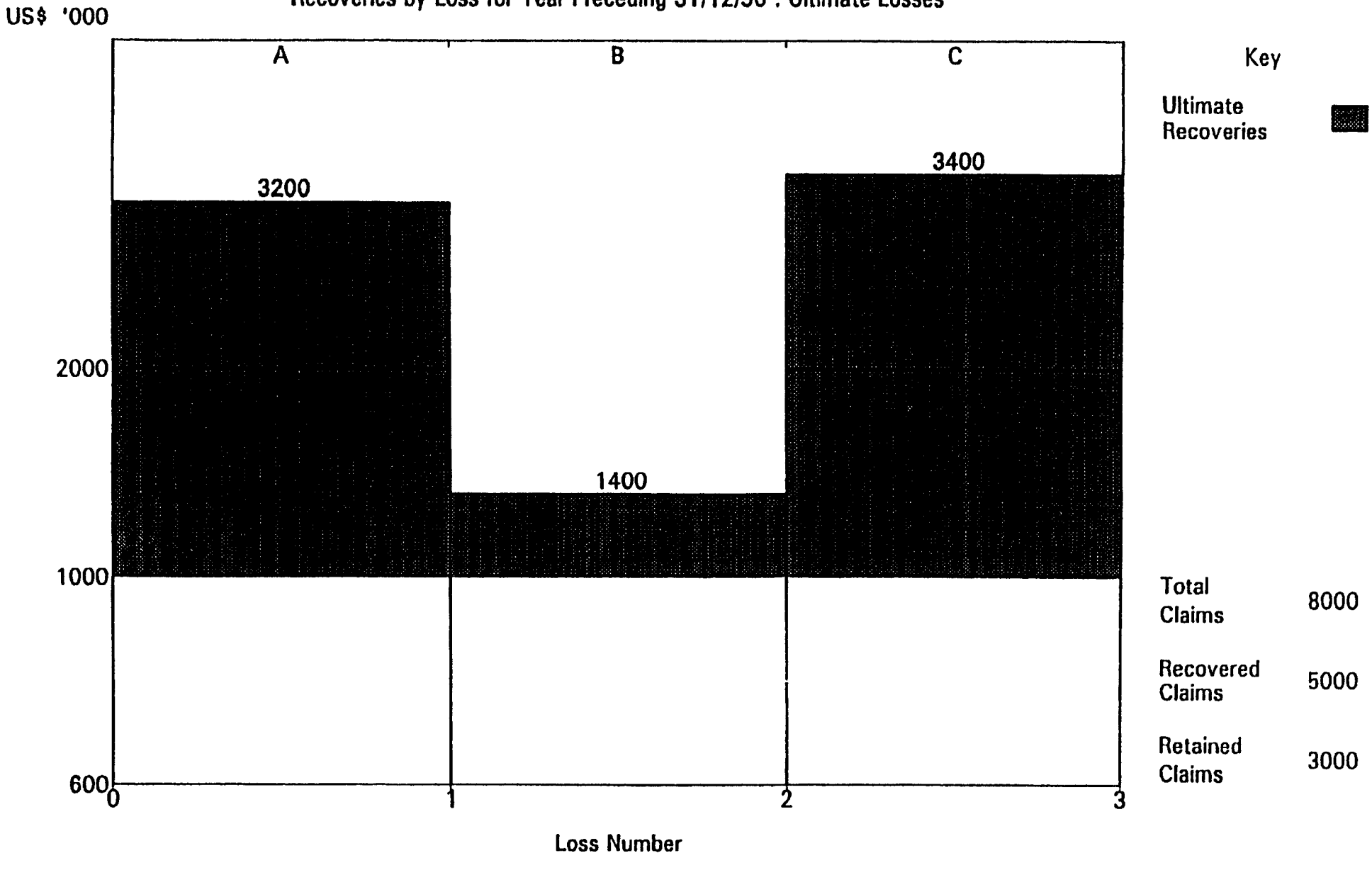
Example 2 - Date of Loss Basis
Figure 3



Example 2 Date of Settlement Basis
Figure 4



Example 2 Date of Settlement Basis
Figure 5



3. PROJECTION METHODOLOGIES

This section provides an overview of the range of methods for estimating the reserve for outwards reinsurance. It is not intended as a description of all possible methods which are available to the actuary, but is based upon the knowledge and experience of the members of the working party.

For each method described, we will outline the advantages and disadvantages as well as indicating the circumstances under which each method might be appropriate.

3.1. Deciding on an appropriate method

The type of method which will be suitable for a particular office will depend upon several factors:-

- Availability of data
- Type and complexity of outwards reinsurance programme
- Size of outwards reinsurance recoveries relative to gross claims
- Methods used for Gross business
- Purpose of the reserving exercise
- Classes of business written
- Whether or not security of reinsurer is an issue
- Whether premiums need to be considered

These factors are not considered in more detail here as they will become clearer in the following paragraphs when the suitability of each type of method is discussed.

3.2. Types of method

The methods which we will consider here fall under the following general categories, in increasing order of complexity:-

- Ratio methods.
- Projection of 'triangle' data.
- Direct calculation from gross claims.

3.2.1. Ratio Methods

3.2.1.1 These are the simplest methods available and involve calculating some form of ratio, derived from the gross projections, which is then multiplied by the relevant outwards reinsurance figure. The fundamental assumption behind this approach is that the reinsurance claims (or premiums) will have the **same run-off factors** as the gross claims, and hence ratios derived from the gross claims can equally well be applied to the outwards reinsurance claims.

3.2.1.2 Depending on which gross ratios are used, this approach can be used to estimate the ultimate reinsurance recoveries or the reinsurance IBNR. The ratios that could be conceived (and might be used) to derive an estimate of the **ultimate** reinsurance recoveries include the following:-

Numerator	**Denominator**	**Multiply by**	**Notes**
Ult claims	Paid claims to date	R/I Paid claims to date	Separately for each U/W year
Ult claims	Incurred claims to date	R/I Incurred claims to date	Separately for each U/W year
Ult claims	O/S claims to date	R/I O/S claims to date	Separately for each U/W year
Ult claims	Paid claims to date	R/I Paid claims to date	Across all U/W years
Ult claims	Incurred claims to date	R/I Incurred claims to date	Across all U/W years
Ult claims	O/S claims to date	R/I O/S claims to date	Across all U/W years

(Ult = Ultimate, R/I = Reinsurance, U/W = Underwriting, O/S = Outstanding)

3.2.1.3 In each case the numerator and denominator of the ratio are derived from the gross projections and are multiplied by the equivalent reinsurance item, so as to derive an estimate of the ultimate reinsurance recoveries.

3.2.1.4 Similar ratios can be used to derive an estimate of the reinsurance IBNR recoveries. [For example, R/I IBNR = Gross IBNR/ Gross outstanding claims * R/I outstanding claims.] In this paper, IBNR is

assumed to be Incurred But Not Reported claims **plus** Incurred But Not Enough Reported claims.

3.2.1.5 Where a gross account has been divided into a number of reserving categories, then the above ratios can be based upon some form of weighted average across these categories, which can then be multiplied by the corresponding reinsurance amount.

3.2.1.6 Where development data is available, it can be instructive to assess the trend in either the cumulative or incremental ratio of reinsurance to gross claims, either by underwriting/accident year or in total. Trends in these ratios can be projected so as to derive an estimate of the ratio to apply to either future gross claims or ultimate gross claims.

3.2.1.7 If an estimate of future reinsurance premiums is required, then a similar approach to the claims, as described above, can be used. For example, the ultimate reinsurance premiums can be estimated by multiplying the current reinsurance premiums paid (by underwriting year, say) by the ratio of ultimate to current gross premiums received. Although reinstatement premiums must be considered.

3.2.1.8 The actual ratio used will depend on the method used to derive the gross reserves. In practice, it is advisable to use a number of different ratios to give a range of results, and then select intelligently.

3.2.2.1 Advantages of ratio methods

- Simple, easy and quick to calculate.
- Minimal data requirements.

3.2.2.2 Disadvantages of ratio methods

- Misleading results if reinsurance is non-proportional.
- Reinsurance exhaustion or security failure are only allowed for implicitly.
- Assumption that outwards reinsurance will develop in same way as gross business will often be invalid.
- No allowance for cost of future outwards reinsurance premiums (for example reinstatement premiums).
- Reinsurance notifications and receipts may lag behind inwards claims and hence higher run-off factors may be required.

3.2.2.3 Suitability of ratio methods

Ratio methods are preferable in the following circumstances:-

- Where the outwards reinsurance is wholly proportional, with no effective limit on cover (see 2.4).
- For assessing the recoveries due under the proportional element of the overall reinsurance programme.
- Where data availability is such that no other methods are practical.
- For getting a very **rough** indication of the possible future reinsurance recoveries.

3.3. Projection of 'triangle' data

3.3.1 This usually involves projecting a triangle of outwards reinsurance data, in exactly the same way as we would for gross claims. Alternatively, the net of reinsurance triangle can be projected and the results subtracted from the gross triangle projection to give the estimated reinsurance reserves. The techniques used here are very similar to those used for gross claims, such as the Chain Ladder, Link Ratio, Curve Fitting, etc.....

3.3.2 Usually this method is applied to a single triangle of reinsurance claims (paid or incurred), with perhaps the facultative and proportional amounts being already deducted from the gross claims before they are projected.

This would however present a problem if fully gross reserves need to be calculated, perhaps for statutory purposes. In the USA, the NAIC certification process was initially based on net reserves. This has now been extended to require a certification on the value of gross reserves also. In the UK, the NAIIO return is still only on a net basis. **It seems likely that any UK actuarial opinion would include an estimate of both gross and net reserves.**

3.3.3 Depending on the type and extent of the outwards reinsurance, the development data can prove to be quite volatile, which makes the use of a triangle approach very difficult. Furthermore, if the outwards programme changes each year, then the development may not be consistent from year to year.

3.3.4 The actuary using this approach needs to be careful that the estimated reinsurance run-off factors are **consistent** with those estimated for the gross claims. For example, if only a small development is expected for a particular underwriting year's gross claims, then a much higher factor for the outwards reinsurance might only be justified if there is a significant lag in receiving or recording reinsurance recoveries.

Always look at the Gross, Reinsurance and Net IBNR to ensure that, after the calculated projections, the numbers look sensible and reasonable.

3.3.5 As with gross or net reserving, graphical viewing of the development by year of account can be instructive. This is especially so for assessing whether the estimated ultimate position seems sensible and reasonable, and also for presentation purposes.

3.3.6 In theory, the techniques can be applied to both reinsurance claims and premiums, the latter of which can show significant development, particularly for an inwards reinsurance account which is heavily protected.

3.3.7 The techniques could also be applied to a number of reinsurance triangles, by subdividing the reinsurance into types such as Marine/Non-Marine, Treaty/Facultative, Proportional/Non-Proportional.

3.4. Advantages and disadvantages of Triangle Methods

3.4.1 Advantages of triangle methods

- Simple, easy and quick to calculate.
- Minimal data requirements.
- Better than ratio methods if outwards R/I has different development pattern to gross.
- Graphical viewing of the development of the outwards reinsurance can give some insight into the reserves required for outwards reinsurance.

3.4.2 Disadvantages of triangle methods

- Very difficult to ensure correct consistency between gross reserves and reinsurance reserves, particularly where programme is complex.
- Potentially misleading results if reinsurance is non-proportional.
- Reinsurance exhaustion or security failure are only allowed for implicitly.
- May be necessary to project each year of account separately if outwards programme changes between years.
- Development of reinsurance may be too unstable for practical application of triangle methods.

3.4.3 Suitability of triangle methods

Triangle methods are not usually considered to have much advantage over ratio methods, but can be used in preference to ratio methods where:-

- The gross and reinsurance run-off factors are thought to be different.
- An assessment of the development of the reinsurance recoveries is required, possibly by type of reinsurance.

Triangle methods do however have the advantage that they may give some information on the development of the reinsurance recoveries, which simple ratio methods usually ignore.

3.5 Direct calculation from gross claims

3.5.1 Where there exists a defined relationship between the inwards gross claims and the reinsurance recoveries, then this approach is to be preferred.

3.5.2 The complexity of the techniques which fall under this general heading is quite wide and depends mainly on the nature of the outwards programme. In each case though, the reserve for reinsurance recoveries is derived directly from the calculation of the gross claim estimates, rather than as a separate entity. This makes logical sense as the reinsurance recoveries must depend on the gross claims.

3.5.3 To explain how to use these methods, we will consider three types of outwards programmes where this 'direct' approach can be used :-

- A single excess of loss programme.
- An aggregate programme, which applies after everything else.
- A complex London Market type programme.

In each case we will assume that the necessary gross estimates have already been derived.

3.6 The Direct Approach

3.6.1 'Direct' approach : Single excess of loss programme

3.6.1.1 In this situation, there is usually an account which is protected by a single excess of loss programme (for example Motor). We will assume that the following have been calculated or estimated for the purposes of the Gross reserving:-

- Number of claims for each year which have already exceeded (on a paid or incurred basis) the reinsurance retention. [Denote by N1(y)]
- Number of claims which are ultimately expected to exceed the reinsurance retention. [Denote by N2(y)]

3.6.1.2 The procedure for estimating the reinsurance recoveries would then be:-

- For each of the N1(y) currently advised claims, estimate their ultimate value and consequently their ultimate reinsurance recoveries. If the reinsurance is indexed, then this will involve adjusting the retention and/or cover using an estimate of when the claim will settle and what the rate of claim inflation will be in the interim.
- Calculate the estimated number of IBNR claims for each year. [Equals N2(y) less N1(y). Denote by IBNR(y)]
- For each of the IBNR(y) claims estimate their ultimate value and consequently their ultimate reinsurance recoveries. This may involve assuming a distribution for the claims.

3.6.1.3 It may be advisable to test the effect on both the net or gross reserves, and the reinsurance recoveries, of different claim assumptions. Construction of an assumed aggregate claim amount distribution will allow explicit estimates to be made of the variability in the net/gross/reinsurance reserves. Alternatively, simulation can be used to assess this variability.

3.6.2 'Direct' approach : Aggregate reinsurance contract

3.6.2.1 This describes situations where there exists an aggregate reinsurance contract which applies after everything else (eg aggregate excess of loss, Stop Loss, etc).

3.6.2.2 The most common method used to estimate recoveries under such contracts is simply to apply the estimated gross results to the contract so as to assess the recoveries. Thus, if the contract provides unlimited cover above £100m and the estimated gross reserves are £120m, then there are estimated to be £20m recoveries. However, this approach ignores the inherent variability that there is in the gross reserves.

3.6.2.3 The preferred approach to estimating the recoveries under such a contract is to derive a distribution of the size of the gross reserves.

3.6.2.4 This distribution can then be applied to the aggregate contract to assess the recoveries in each case. The probability distribution of the gross reserves is thus used to derive the probability distribution of the net and reinsurance reserves.

3.6.2.5 The actual gross and net reserves are then set on a consistent basis, using this distribution.

3.6.3 'Direct' approach : Complex London Market type programme

3.6.3.1 In such a situation, there will be a large number of different types of reinsurance affecting different classes of business such as:-

- Property/Casualty covers.
- Facultative/Treaty
- Proportional/ Non-Proportional
- Per-Risk Excess covers
- Catastrophe/Event covers

- Different specific programmes for each class of business
- Whole account covers applying after the specifics
- Umbrella contracts covering a number of classes

3.6.3.2 In addition, there will be many complex variations on the standard contract wording, which affect the way in which the contracts operate on their own and with each other. Some of these are as follows and are covered in Section 2:-

- Variable contracts (Top and Drops, StepDowns, etc)
- Warranty contracts
- Franchise contracts
- Reinstatement Premium Protection policies
- Injection layers

Additional complications arise due to:-

- Mixed inception and expiry dates.
- Date of settlement / Date of loss basis
- Overlapping contracts
- Mixed slip rates on same programme

3.6.3.3 Although we have given a brief introduction to many of these variations in Section 2, it would be inevitable that the actuary seeking to estimate reinsurance reserves for such an account would meet variations not covered here. Consequently we will describe the methodology in general terms and an example will be used to demonstrate the technique.

3.6.3.4 The general approach can be broken down into the following steps:-

1. Gain an initial overview of the reinsurance purchased over the years covered by the reserving exercise. This will include assessing the importance of the outwards reinsurance by assessing the ratio of net to gross claims paid and outstanding.

2. Gather all available information on the reinsurance programme over the years covered by the exercise. This will include:-

   - Types of reinsurance purchased (Facultative, Treaty, Proportional/Non-Proportional, etc)
   - Contract schedules (giving basic contract details such as layers, reinstatements, etc).
   - Graphs of Non-Proportional catastrophe programmes, if available.
   - Current 'burn' figures for Non-Proportional contracts (ie current values for paid and outstanding amounts, and also the **remainder**).
   - Details of any commuted contracts.
   - Premium details.

3. Gain a clear understanding of the reinsurance that is available to protect each of the classes used to assess the gross reserves. Establish the 'order' in which the different types and programmes of reinsurance apply. Drawing diagrams to explain this can be useful.

4. Gather all claims information arising from the gross projections, so that the reinsurance programme can effectively be "worked through" This will include:-

   - Gross paid, incurred and ultimate estimates, by currency and underwriting year, of every claim which can cause recoveries under any of the Non-Proportional covers. These will need to be broken down by each specific outwards programme if separate programmes apply to different sources of claim.
   - Separate triangles of 'small' claims which will not affect these Non-Proportional covers.
   - Estimates of numbers of IBNR claims and their distribution (which may be simplified into grouped data and have a range of assumptions for scenario testing)

5. Apply the reinsurance programme to the claims already notified, using previously estimated gross ultimates. This will involve:-

- Applying the Facultative and Proportional covers first, so as to derive estimates net of these covers. These are sometimes referred to as 'Gross Net' figures.

- Apply any per-risk Excess of Loss covers.

- Apply the Non-Proportional catastrophe covers to each of the claims which, after prior reinsurances, still affect these covers. This will be a particularly complex and lengthy part of the procedure as these covers are invariably complex.

6. Estimate the recoveries from the calculations of the previous step for the notified claims.

7. Do steps 5 and 6 for the estimated IBNR claims, using the assumed distribution for the IBNR claims.

8. Repeat steps 5 to 7 using alternative assumptions regarding gross estimates and IBNR claims so as to derive an estimated distribution (which may only have 'Optimistic', 'Central' and 'Pessimistic' observations).

9. If outwards reinsurance premiums are also to be estimated, then it will be necessary to calculate the premiums which arise as a result of the claims 'going through' the outwards programme.

3.6.3.5 The complexity of the above procedure cannot be overestimated and will invariably take a considerable amount of time and effort. It will often be the case that the approach adopted for Net or Gross reserving will need to be modified substantially so as to allow such a detailed approach to be used for estimating the reserves required for outwards reinsurance. For example, if a triangle method is currently applied to a number of triangles, broken down by class of business, then this can no longer be used if there are outwards reinsurance contracts which apply on an individual claim basis.

3.6.3.6 The methodology used to estimate recoveries under a property catastrophe programme is explained further in Section 2.

3.6.3.7 In practice, an amalgam of the different types of method described above will be used.

3.6.4 Advantages of "Direct" Methods

- Mirrors process of outwards recoveries, giving direct and consistent association between gross and reinsurance recoveries.
- Explicit allowance can be made for reinsurance exhaustion.
- Cost of reinstating outwards cover can be explicitly calculated.
- Use of graphical methods to display outwards programme gives management an informative picture of the programme.
- Reinsurance security failure can be allowed for explicitly.
- Changes in outwards programme are allowed for explicitly.

3.6.5 Disadvantages of "Direct" approach

- Often a complex, lengthy procedure.
- Data requirements can be onerous.
- Understanding the operation of the outwards programme can be difficult and time consuming. It may involve examination of several contract wordings.

3.6.6 Suitability of "Direct" methods

- Essential for catastrophe-type Non-Proportional covers where either horizontal or vertical exhaustion is a possibility.
- Can also be useful where a simple Non-Proportional contract protects an account.
- Only possible where data on the outwards programme is readily available and preferably where a clear logic and structure of the programme has been pre-defined.
- Not worth using where there is little outwards reinsurance bought or where the programme is mainly proportional.
- Useful where security of reinsurers is an issue.

3.7 Types of Method: Conclusions

We have outlined three broad categories of methods of estimating outwards reinsurance recoveries:

- Ratio methods
- Triangle methods
- Direct methods

The methods most commonly in use fall under the first two categories and are relatively simplistic. Many companies still base their reserving on net triangulations, with no special consideration given to the nature of the outwards reinsurance.

Use of more detailed methods, such as those outlined in the third category above, can give the actuary an insight into the sensitivity that the net reserves might have to the outwards reinsurance programme.

In practice, an amalgam of the various categories of the method will be used. For example, a simple Ratio method might be suitable for estimating proportional recoveries, followed by a Direct approach for the non-proportional recoveries.

4. PRACTICAL CONSIDERATIONS AND DIFFICULTIES

4.1. Data Problems

The use of the methods in the previous section may be restricted by practical considerations concerning the data.

4.1.1 Inwards data is usually split into homogeneous groups for projection It may be possible to derive further subdivision of data for projection to assist with outwards reinsurance. Otherwise, some assumptions need to be made.

4.1.2 Outwards reinsurance may cover more than one inwards business category. This occurs often for the "Generals" programme, and separate examination by type of loss may be required.

4.1.3 It is not always practicable to allocate outwards recoveries to specific inwards groups.

4.1.4 If they cannot be allocated in this way, then using just one set of development factors for outwards claims (with their different profiles each year) may produce inconsistent and erroneous results.

4.1.5 The only available data may be claims triangles **net of outwards recoveries**. These are often less smooth than inwards data, especially if outwards reinsurance protection overlaps inwards groups as detailed above and the allocation is not exact. If inwards and outwards years do not coincide, then recoveries can be made in the year following, or the year before, that of the inwards risk, and this distorts the data. This can also lead to a mismatching of reinstatement premiums which could be greater for inwards than for outwards business, or vice versa. So generally, it is necessary to ensure consistency of projections of net claims, and corresponding gross and reinsurance claims.

4.1.6 **Historic data** for determining the distribution of claim sizes may not be available. Projecting recoveries for Excess of Loss layers, particularly for Long Tail business, is difficult. US general Casualty business, especially, can have movements in incurred loss development after 30 or more years. Latent claims (such as asbestos or pollution) can cause significant movements.

4.1.7 **Individual large claims are often projected as a point estimate**. This can overestimate the net position, eg gross ultimate claim is £1m with reinsurance cover excess of £1m, therefore net ultimate claim is £1m. A range of estimates gives a net ultimate claim less than £1m. If

a range of estimates is used how are the parameters and assumptions derived?

4.1.8 **Inconsistency between gross and net outstanding claims.** For example, a company may have been informed of potential pollution claims and considers it prudent to make some reserve for these. However, although the size of claims would indicate that an outwards recovery could be made, the situation is not sufficiently clear to justify submitting a claim to the reinsurers. This can overstate the net reserves.

4.2. Security of Reinsurers

This is possibly the most important factor when considering reinsurance and net reserves, and the actuary has a number of available options in dealing with this problem:-

4.2.1 Make no allowance for future non-payments

Advantages

- Easy to apply
- Consistent between companies
- The management of the company knows where it stands in regard to the actuarial advice received

Disadvantages

- May be contrary to generally accepted accounting principle of prudence
- Can provide unrealistic figures and it may lead the management of the company to question the credibility of the actuarial advice
- Is not conservative and the necessary net reserves may well be underestimated as a result

4.2.2 Apply a single factor across all reserves

For example, assume that 5%, 10%, 15%, ... of future recoveries will not be met.

Advantages

- Easy to apply
- More realistic
- Easy to monitor the accuracy of the assumptions

Disadvantages

- Subjective, and so inconsistencies will arise between companies and to some extent within companies
- Difficult to verify

Corollary

- A different factor may be applied to each underwriting year. In selecting the factor, certain features of the business should be considered. For recent years a smaller proportion of non-recoverables is more likely than for more remote years. Just one or two large claims may trigger the reinsurance and there may be known problems of reinsurers on the programme in these years.

4.2.3 Apply different factors to individual reinsurers

This would be based on knowledge of these companies, including the use of external rating services, eg Bests, Moody, or Standard and Poor.

Advantages

- More objective and realistic
- More transparent to regulatory authorities, auditors, etc
- Realistic

Disadvantages

- Factors to apply to individual reinsurers are subjective to some extent
- Could be difficult and **extremely** labour intensive to apply in practice.

5. FURTHER CONSIDERATIONS

5.1. Rates of Exchange

5.1.1 Exchange rates may considerably affect the erosion of reinsurance limits. If, say, the current exchange rate is £1 = US$1.5 but the wording in the Marine X/L reinsurance Treaty calls for £1 = US$2.5, then a loss expressed in both £ and US$ must be treated differently depending whether it is within or outside the layer.

5.1.2 Consider a loss of £50,000 + US$100,000 from the ground up (FGU), to a layer US$100,000 to xs US$100,000.

5.1.3 At current rates of £1 = US$1.5, the loss is converted to $175,000 and a loss to the layer of $75,000 is indicated, but at the exchange rates in the policy wording of, say, £1 = US$2.5, the loss is US$225,000 and so a total loss occurs to the layer of $100,000.

5.1. This example shows how particular care is needed in understanding the implications of rates of exchange clauses.

5.2. Commutations

5.2.1. Inwards and outwards commutations can have a considerable effect on the development of claims.

5.2.2. When using any form of ratio projection or triangle method, adjustment may have to be made for past commutations. Ideally, all such business should be excluded from inception for triangle methods, but this may not be practicable.

5.2.3. Expected future commutations may also have to be allowed for. Sometimes, contract wording allows for a party to commute unilaterally if it so desires.

5.3. Reinstatement Premiums

5.3.1. In times of cheap reinsurance, and low ROL's, the effect of reinstatement premiums can be limited. In the current market, the effect of reinstatement of cover at 40 or more ROL can be quite dramatic.

5.3.2. As well as proper monitoring of reinstatement premiums (RP), experience of past losses would be helpful in assessing the effect of future RP's.

5.3.3. In a spiral situation, and generally when reinsurance is more akin to a trading market (arbitraging), RP's can be substantial in size and most certainly **material**.

5.4. Reinstatement Premium Protection

5.4.1. Until recently, one significant element in the spiral market was the purchase of reinstatement premium protection policies (RPP). The claims payments recovered were the amounts of the RP's to be paid.

5.4.2. One sinister side effect was a situation where net profits were sometimes enhanced by losses occurring. Inwards reinstatement premiums were received and no net outwards reinstatement premiums were paid because they were recovered under the RPP's. (Where was the insurable interest?)

5.4.3. The only method of reserving for RPP's is first to understand exactly what is going on, and secondly to carefully study the effect of RPP's on individual losses. Again, this is fairly labour intensive and time consuming.

5.5. Alternative Reinsurances

5.5.1. As well as traditional one year reinsurances with full risk transfer, there has been a growth of reinsurance with an element of financing, or banking in recent years. The proportion of risk transfer varies considerably between contracts.

5.5.2. These financial or finite risk or long term reinsurances may have fully justifiable and commercial reasons, or there may be some attempt to hide the real situation inside a company or syndicate.

5.5.3. The actuary must clearly ensure that he fully understands exactly what reinsurance has been purchased and when any financial element exists. Often, this is not easy. He must then deal accordingly with the contract.

5.6. Allocation by Year of Inwards Risk

5.6.1. For the effective running of an insurance company, reinsurance statistics **must** be kept on two bases. First, on an LOD basis, and secondly on a basis where the outwards risks are allocated back to the year of the corresponding inwards risks.

5.6.2. The LOD basis is needed for management of reinsurance recoveries, including commutations.

5.6.3. For statistics, it is essential for outwards reinsurance to be allocated back to the year of the inwards risk. Otherwise, the **wrong** underwriting year may get the benefit of the recovery. In extreme situations, this can lead to negative net paid, outstanding, incurred or ultimate claims.

Consider the projection of net or reinsurance underwriting year results in the situation where outwards reinsurance is not so allocated. Projecting claims becomes a nightmare and the results are meaningless.

5.7. A Focused Market Loss

5.7.1. Most practitioners do not appreciate the effect on claims processing of an important market loss.

5.7.2. Piper Alpha was such a loss. Enchova (which occurred just before the Piper Alpha loss) was ignored to a large extent and the projected development of the gross, and more especially the reinsurance or net loss was seriously affected.

5.7.3. Clearly the problem for reinsurance or net projection is where the gross loss is underestimated and the actual loss may result in a vertical, or more likely horizontal, exhaustion of cover.

5.8. Joint Property/Casualty Reinsurance

5.8.1. Until 1984/85, it was easy and acceptable to purchase a reinsurance that responded to both property and casualty (liability) losses. After this time, market practice normally dictated that separate reinsurance was necessary (although see earlier discussion in 2.14 of umbrella coverage).

5.8.2. A significant problem may occur with such joint reinsurance. Non-Marine reinsurance coverage usually dictates that losses are on a DoL (date of loss) basis.

5.8.3. Initially, the shorter tail property losses will make up the retention. At that stage, any loss to the Layer will be a recovery to the property account. As the longer tail casualty losses emerge, then they will not only occur to the Layer, but casualty losses occurring early in the year will displace any later property losses. These property losses will become recoveries, and the casualty losses will not initiate any recoveries as they will make up the retention.

A similar situation may occur if coverage becomes exhausted, with property losses then not being recovered, and the Short Tail result will worsen.

5.8.4. This will create a strange effect in that an account with no movement in inward losses will change as losses from an entirely separate account affect this joint reinsurance.

5.8.5. This problem is similar to that discussed in Section 2.13.

5.9. Specific Losses

5.9.1. Latent claims, such as asbestos or pollution claims, must be carefully considered. The bulk of these losses emerge from the 1970's and earlier. The incidence of poor reinsurance security will be much higher than for more recent years.

5.9.2. The intent of the reinsurance wording will be more remote. Legal interpretation will be of more importance, and hence the reinsurance may be less effective.

5.9.3. Care must also be taken when dealing with market practice. Will asbestos losses paid under the Wellington Agreement be recoverable?

5.9.4. In more recent years, US Savings and Loans losses and UK Mortgage Indemnity losses may pose problems. What is the definition of the **event** causing the loss? As with asbestos and pollution, **when** did the loss occur? How will this uncertainty affect reinsurance recoverables? The actuary must keep in touch with current practice, legal opinions and more general information about such factors.

5.10. LMX Spiral

5.10.1. The enormity of problems in the LMX spiral, mainly caused by Marine losses, and Non-Marine losses but in the marine market, is well documented. The uncertainty of the gross losses is so important, as coverage may well become exhausted, both vertically (size of loss) and horizontally (number of losses).

5.10.2. The main point is that losses must be considered individually (on a Direct basis) and by projecting the gross loss, the reinsurance recoveries can be ascertained.

5.10.3. In view of the complexities of the reinsurance arrangements, especially when complicated by the consideration of the collection of losses interacting together, particular care is needed.