

## **MORTGAGE INDEMNITY GUARANTEE**

### **REPORT OF THE PECUNIARY LOSS WORKING PARTY 1992**

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## **1. EXECUTIVE SUMMARY**

- 1.1 This paper describes the recent work of the Pecuniary Loss Working Party (PLWP).**
- 1.2 Section 2. provides the context for the recent work and describes the decision to concentrate on Mortgage Indemnity Guarantee (MIG).**
- 1.3 Section 3. contains descriptions of recent developments in the MIG marketplace, covering the UK housing market, reserving practice and product development.**
- 1.4 A particular methodology has been used to describe the complex relationships between factors affecting MIG. This methodology is described in general in Section 4.**
- 1.5 Two relationship models have been developed and are also described in detail in Section 4. The Macro Relationship Model describes the economy wide relationships, whilst the Micro Relationship Model describes the relationships relevant to an individual risk.**
- 1.6 Section 5. describes the development from the Macro Relationship Model of a Catastrophe Warning Indicator.**
- 1.7 Section 6. describes the continued development of a Premium Rating and Reserving Model, which has been assisted by the development of the Micro Relationship Model.**
- 1.8 Next steps are covered in Section 7. In particular, the PLWP requests feedback on the work to date and direction for the future, both for MIG and other product lines.**

## **2. BACKGROUND**

### **2.1 Background**

Previous PLWP investigations have included MIG, and resulting papers have been presented to GIRO conferences. The last such paper, presented to the 1991 GIRO conference, concentrated on developing a stochastic model to predict future MIG experience. The discussion at the 1991 GIRO conference took place at a time of increased awareness of MIG and of increased interest in the significant impact of likely future experience.

### **2.2 PLWP Membership**

**2.2.1** The 1992 PLWP was formed after the 1991 GIRO conference, including individuals employed by lenders, by insurers, in consultancy, and in the Government Actuary's Department.

**2.2.2** The membership is as follows:

P J Akers (Chairman):	lender,
P Delbridge	: consultant,
D Fuller	: insurer,
J Leigh	: consultant,
G Masters	: insurer,
A Silverman	: adviser to supervisor.

**2.2.3** Whilst it is certainly true that the PLWP has benefited from its broad composition, the inclusion of suppliers and purchasers of the MIG product at a time of its review and renegotiation has complicated the PLWP's progress and access to information in particular.

### **2.3 Coverage**

**2.3.1** The PLWP decided to concentrate attention to cover one area in depth rather than spread resources too thinly. In view of the current interest, the area chosen was MIG.

**2.3.2** This paper covers UK MIG in detail. MIG in overseas areas is described in Appendix A1.

## 2.4 Methodology

Standard working party methodology has been used throughout, with interested individual members progressing particular elements and submitting their work to group review.

## 2.5 Acknowledgements

### 2.5.1 The PLWP Chairman places on record his thanks to:

- PLWP members, whose enthusiasm has remained high throughout,
- all support staff at the Institute of Actuaries,
- his secretary, Jane Rowell, who has produced the final paper from drafts of varying legibility.

### 2.5.2 Particular thanks are due to Magorah Maruyama, who developed the relationship modelling methodology described in Section 4. below, and to Gareth Morgan, whose book "Images of Organisation" contains a detailed description of this methodology which has been used as the basis for the description contained in Section 4.

### 3. MARKET DEVELOPMENTS

#### 3.1 UK Economy/Housing Market

3.1.1 During the last couple of years or so the UK economy has been in the doldrums, and in particular some of the economic factors affecting the incidence and intensity of MIG claims have continued to play a major role. As mentioned elsewhere in this paper, there are several factors that can give rise to a MIG claim, but the occurrence of several of these factors at the same time has led to the current catastrophic position. Although mortgage interest rates have generally been reduced over the last two years or so, there has been growing unemployment and falling house prices, particularly in the South of England, and with growing public unease about investing in the housing market, there has continued to be a depressed housing market for some time. Recent evidence suggests that the recession is likely to persist, which points to a continued depressed housing market, notwithstanding efforts by lenders to come up with initiatives to stimulate confidence in the housing market. It is thought that any such initiatives by lenders will, at best, have only marginal effects on the housing market unless there is an accompanying improvement in the relevant economic conditions.

3.1.2 The following table shows the trend in number of properties repossessed during each of the last five half years together with the number of mortgages in arrears at the end of each period:-

	H1 1990	H2 1990	H1 1991	H2 1991	H1 1992
Repossessions in Period					
	16,560	27,330	36,610	38,930	35,750
12+ months in arrears					
	21,580	36,100	59,690	91,740	113,869
6-12 months in arrears					
	87,790	123,110	162,210	183,610	191,280

- 3.1.3 Care needs to be taken in interpreting the above table because as mortgage rates are reduced, there is a corresponding increase in the number of months a particular mortgage is in arrears. Hence the increase in the number of cases 12+ months in arrears is partly explained by the reduction in mortgage rates..
- 3.1.4 Some lenders have tried to stimulate confidence in the housing market by accepting reduced mortgage payments so as to avoid repossession. This is to some extent reflected in the figures shown above. However, there has, as a consequence, been a large increase in the numbers of mortgages 12+ months and 6-12 months in arrears. There is then the danger that all that these lenders are doing is to delay the ultimate situation of repossession and thus deferring insurance claims. This is clearly a matter of concern for insurance companies and lenders in seeking to determine the amount of the provisions to cover future claims arising from contracts already written.

## 3.2 Reserving

Since the report presented to GIRO in 1990 there have been some significant changes both in the reserving practice of insurers and the MIG contract itself. This section deals with the changes relating to reserving, whilst the next section deals with changes in the product.

### 3.2.1 Unearned Premium Reserve

- 3.2.1.1 One of the provisions that needs to be set up at the end of an accounting period is that for unearned premiums.
- 3.2.1.2 According to the most recent ABI SORP on Accounting for Insurance Business "Written premiums should be regarded as earned evenly over the life of the policy, unless the exposure to risk is uneven, in which case the written premium should be regarded as earned in accordance with the risk profile. Provisions for unearned premiums at the end of an accounting period should be calculated accordingly." Thus the

pattern of the claims experience is examined from year to year to review the basis for earned premiums, although changes are unlikely to be made unless significant changes occur in the distribution of the claims. However, it is very difficult to judge what the long term pattern is, as is demonstrated later in Figure 3.1 which shows the diversity of the treatment of earned premiums by different companies.

- 3.2.1.3 As a result of the examination of its pattern of claims experience, one company changed its basis, which had been in force for some decades from earning premium almost uniformly over a period of eighteen years to the following basis:-

% of Written Premium earned in year

Year	1	2	3	4	5	6	7	8	9	10	11
%	0	5	15	20	18	14	10	7	5	3	3

- 3.2.1.4 The percentage of written premiums which are unearned at the end of each year are then as follows:-

% of Written Premium unearned at end of year

Year	1	2	3	4	5	6	7	8	9	10	11
%	100	95	80	60	42	28	18	11	6	3	0

- 3.2.1.5 During the two year period since these revised patterns were set, the claims experience has shown far more claims than previously occurring early in the life of a policy. On the basis of data currently available in respect of claims notified to date the pattern of earning of premiums would be as follows:-

% of Written Premium earned in year

Year	1	2	3	4	5	6	7	8	9	10	11
%	1	6	20	26	20	12	7	4	2	1	1

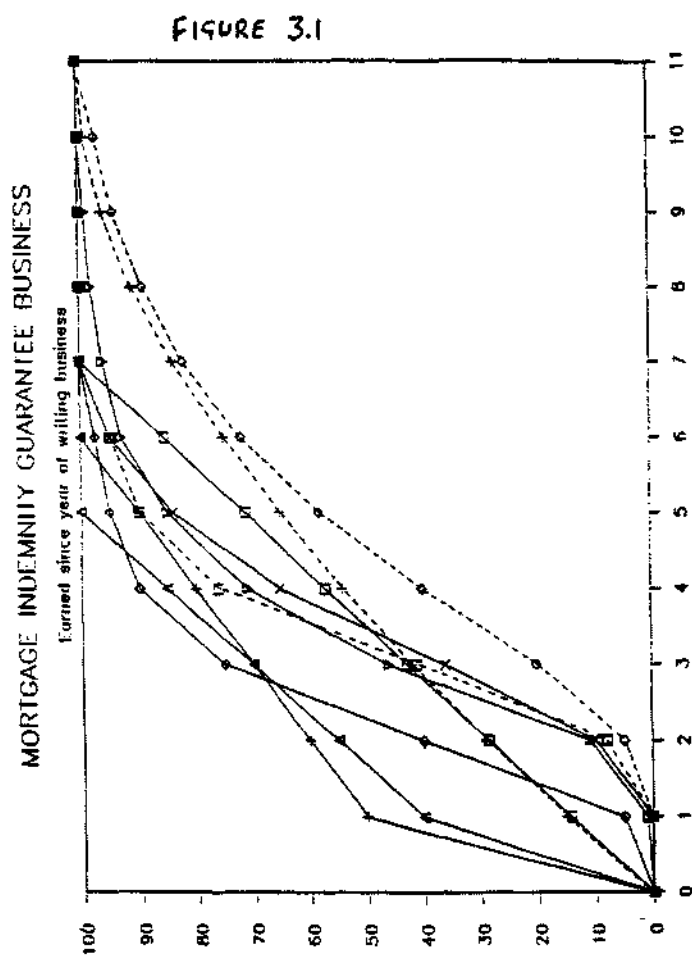
**3.2.1.6** This latter investigation includes experience of claims originating from business written in 1988 and payments made in years of development 3 and 4. It is thought that the large payments made to date have somewhat disturbed the true position. Eventually (ie four to five years time), the spread of claim numbers and payments for the business written around three to five years ago is likely to indicate that the above picture is false as the problem of the delay in selling properties will enhance payments made in later years of development. As a result of this expected outcome, premiums would be earned on average later in the period of cover than the above table indicates, and therefore the pattern of earning of premiums has not been amended in line with the above distribution which was based upon the most recent available data with respect to notified claims.

**3.2.1.7** The distribution of claims over the policy term for MIG contracts may be affected by several factors. Whether or not a change in the distribution of claims should lead to a revision in the basis of earning of premiums is a matter for consideration. For example, it may be thought that premiums should be earned at a faster rate because:-

- a) greater number of claims, policy terminates at the time of a claim hence all premium earned,
- b) increase in house prices, less likely to give rise to a claim at later durations hence premiums earned earlier,
- c) falling mortgage rates, less likely to give rise to a claim at later durations hence premiums earned earlier.



- 3.2.1.8 On the other hand, factors could give rise to premiums being earned at a slower rate, eg:-
- a) falling house prices,
  - b) increasing mortgage rates,
  - c) increasing unemployment.
- 3.2.1.9 As mentioned elsewhere in this paper, the attitude of lenders with respect to their lending criteria varies considerably. This in turn has an effect on the pattern of earning of premiums of the lender's MIG insurer.
- 3.2.1.10 As a minor consideration, in some cases a repayment of premiums may be made if the mortgage is terminated at an early duration, other than due to a claim. This is rarely allowed for in the pattern of earning of premiums because the policy of repayment of premiums is seldom adopted.
- 3.2.1.11 Provided the pattern of earned premiums is within the guidelines of the ABI SORP, short term factors affecting claim occurrences are unlikely to lead to a change in the pattern of earned premiums adopted.
- 3.2.1.12 In the light of all the uncertainties touched on above regarding the incidence and intensity of claims arising from MIG business, it is not surprising that insurance companies differ widely as regards the pattern of earning of premiums. Figure 3.1, which includes patterns for some of the major insurers in the MIG market and for other insurers writing MIG business, together with some theoretical patterns, clearly shows the wide variation in the pattern of earning of premiums.



## **3.2.2 Claims Reserves**

- 3.2.2.1** This section covers the provisions in respect of claims covering known reported claims, incurred but not reported claims (IBNR) and future claims.
- 3.2.2.2** First we mention a couple of recent changes in respect of claim reporting and claim settlement and then go on to deal with changes in respect of reserving practices and levels.
- 3.2.2.3** There has been an increase in the average delay in reporting claims owing to the large volume of claims data. The situation now is that there are currently large volumes of IBNR claims. This has resulted from a large backlog of claims in lenders' hands. As at the end of 1991 accounting year, information was more generally available than had been the case in the past from lenders so that insurers could assess both numbers and amounts of IBNR claims, so as to reflect more accurately the expected costs of claims in their accounts. This is an example of greater cooperation between lenders and insurers so as to achieve good relationships at a time when relationships may otherwise have become strained.
- 3.2.2.4** In respect of claim settlement there has been a change in the speed of settlement of claims. Insurers are generally concerned that lenders should be doing everything possible to reduce the cost of a claim, for example by pursuing the borrower as much as possible to obtain as much payback as possible. Some insurers therefore insist that investigations take place and that claim forms are completed fully. This has led to a slowing down in the settlement of claims, and as a consequence at the end of an accounting period there is now an even higher level of reserves for outstanding claims than might have been expected on the basis of the large number of claims which have been reported.

- 3.2.2.5 The provision for known claims (ie where the property has been sold and the insurer has been notified), which have not been settled, could be arrived at by applying an assumed average amount to the number of reported outstanding claims. Owing to the changing patterns of average severity from one year to the next, the most appropriate method for setting up a claims reserve for known claims is likely to be the individual case estimates, as the eventual cost of a claim to the insurer is generally known on notification.
- 3.2.2.6 For IBNR claims, a separate projection of numbers and average amounts is likely to be required. The recent situation (ie as at end of accounting period for 1991) is that there is a large number of such cases owing to a backlog of claims in the hands of lenders. Two methods of assessing the number of such IBNR cases are:-
- a) obtain from the lenders the total number of such cases and apply your known percentage of business with each lender to obtain your IBNR number,
  - b) preferable to (a) if available - obtain from each lender actual details of those cases relating to business written by your company.
- 3.2.2.7 An indication of the average cost of a claim may also be obtained. Otherwise the average cost of recently notified claims may be adopted as it is difficult to assess how the average cost of a claim is likely to change over time, eg the average cost may increase if mortgage rates rise and hence so do arrears, or it may decrease if serious arrears cases have been dealt with, and the less severe cases are in the IBNR category.

**3.2.2.8** We now turn to the third category of provision mentioned in the introduction to this section, that covering future claims.

**3.2.2.9** In accordance with the most recent ABI SORP "If it is anticipated that the enterprise will incur operational losses during the unexpired period of risks on its existing insurance contracts, then, following the prudence concept, it will be necessary to create an unexpired risks provision additional to the claims provision and the unearned premium provision." That is, a company's global provisions should be sufficient to cover all future losses on current business, although in estimating such losses allowance should be made for the accruals concept of allowing for future investment income which relates to business already written by the end accounting date. Hence, if the margins in the technical reserves are insufficient to cover the expected discounted future losses, then the ABI SORP calls for the setting up of an Additional Provision for Unexpired Risks (APUR).

**3.2.2.10** Insurance companies writing MIG business have adopted different practices in regard to their accounting policy. Many companies, over the years, have allowed only for reported claims and claims which are strictly IBNR, that is to say, where the repossessed property has been sold. Recently most companies have provided an additional amount in respect of repossessed but unsold properties, ie cases which have not yet become claims. They have judged that this claim cost is one for which a specific provision needs to be made. In former times such a provision may not have been needed if the future earned premium and investment income were deemed to be adequate to meet emerging claims. Not all companies providing for this latest category of claims have identified it as an APUR, instead they may have added an amount to their outstanding claims reserve, IBNR reserve or created some kind of claims equalisation reserve.

- 3.2.2.11 Other companies judge that in addition to providing for repossessed properties, an additional allowance is needed for the number of arrears cases which are expected to result in future repossession. The amount of any such provision should be after allowing for future investment income and future earned premiums. Where companies are not making such allowances based on their best expectation of future losses, albeit subject to much uncertainty, the presumption is that the global provisions include sufficient margin to cover future losses if the guidelines of the SORP are being adhered to. In the case of some companies, this currently implies that they have very large margins in their global non-MIG provisions.
- 3.2.2.12 One interesting feature of the level of reserves set up as published by individual companies is to make comparisons between the reserves and the share of the market each insurer underwrites. As a result of this an estimate of the relative strengths of reserves for different insurers can be made. In addition, an estimate of the total loss for the market can be made, although a wide ranging result is obtained by this method and must therefore be treated with caution.
- 3.2.2.13 Lenders also set up reserves in their accounts to reflect doubtful debts arising from doubtful mortgages. The form of reserves follow on similar lines to those referred to above for insurers. Some lenders set up a Specific Provision, which is a reserve to cover known incurred debts, whilst other lenders may go further and also set up a General Provision as a reserve for doubtful debts which have not yet been incurred.
- 3.2.2.14 In the case of notified claims the actual claim cost is generally known and so no assumptions are required. This is also true in the case of IBNR claims where the lenders give full information.

- 3.2.2.15 However, assumptions regarding numbers of claims have to be made in respect of cases where the property has been repossessed or if the mortgage is in arrears.

Concerning the occurrence of a claim following repossession, there are two factors to consider:-

- 1) percentage of repossessions giving rise to a loss,
- 2) percentage of repossessions having MIG cover.

- 3.2.2.16 The combination of these two factors gives us the number of claims likely to arise out of a known number of repossessions. In the current economic climate a range of figures is being adopted. The extremes appear to be around 70% and 100%, depending upon the insurer, the lender, and the lending criteria.

- 3.2.2.17 An assumed average cost per claim can then be applied to the estimated number of claims to obtain the expected cost of claims arising from known repossessions. Some consideration of how the future average cost may differ from the current average cost has to be given (examples of the factors affecting average cost have been given earlier in this section). This is an area of subjectivity as the average cost of claims over the last couple of years has increased greatly. Most insurers adopt a future average cost similar to that currently being experienced. This tends to be in the range £12,000 to £17,000. A lot seems to depend upon any recovery in, or any further depression of, the housing market, accompanied by the lender's attitude towards repossession, their pursuance of defaulters and their policy of selling repossessed properties.

3.2.2.18 Those insurers/lenders setting up provisions for future claims arising from current known arrears cases have to make additional assumptions regarding numbers of claims which will arise. Some lenders provide details of arrears cases for their insurers in the following categories; 3-5 months, 6-11 months, 12+ months. One approach is to assume that 40%-50% of cases 6+ months in arrears will lead to repossession. Alternatively, different percentages can be applied to the three categories of number of months in arrears mentioned above. Clearly, very much depends upon the scale of the housing market depression and also the recession - related economic factors affecting MIG claims.

3.2.2.19 Facts that can be used to assess the position are:-

- 1) 54% of mortgages 6+ months in arrears at end of 1989 led to repossession in 1990,
- 2) 50% of mortgages 6+ months in arrears at end 1990 led to repossession in 1991.

### 3.3 The Product

Since the report presented to GIRO in 1990 there have been considerable changes implemented and suggested concerning the MIG contract itself.

#### 3.3.1 Premium Rating

3.3.1.1 Following the general increases in premium rates in 1987, a further substantial increase took place in 1991. Insurers imposed increases of the order of 50% which were to be implemented in mid to late 1991. Lenders were forced to adopt these rates otherwise the insurers would have refused to write the business. Lenders however in most cases pass the cost on to the borrower, and in addition receive commission from the insurer on a larger gross premium.



- 3.3.1.2 Typical sets of premium rates used by the insurance industry before and after the increases imposed in 1991 (prior to the product repackaging referred to later) are as follows:-

<u>Loan to Value Ratio</u>	<u>Pre 1991 Increase</u>	<u>June 1992</u>
Up to 90%	£3.50%	£5.00%
90%-95%	£4.50%	£7.00%
Over 95%	£7.00%	£10.00% (If available)

- 3.3.1.3 A variety of rates apply to non-standard loans. For example, extra loadings are imposed for "low start" loans and "self certification" loans.

- 3.3.1.4 At the same time as negotiations took place regarding revision of premium rates further negotiations took place regarding commission terms. At least one lender was prepared to reduce its commission charge from 30% to 15%. With the substantial increase in premium rates, the net effect to the lender in respect of total commission received was a reduction of about 25% compared to that received before the revision.

### 3.3.2 Revised Coverage

- 3.3.2.1 MIG insurers acted during the first half of 1992 to reduce the cover available on MIG for new loans by introducing

- (a) an 80/20 division of all deficiencies between insurer/lender,
- (b) an upper limit on the claim of 20% of the original property value.

- 3.3.2.2 It is understood that element (a) above was included to counter the perceived position that only insurers are paying on bad loans. The 20% share of deficiency borne by lenders will ensure that they feel the financial pain of bad loans. At least some lenders think this change is unnecessary as they already suffer financial loss on bad loans.
- 3.3.2.3 It is understood that element (b) above was included to provide a fixed maximum claim amount on any MIG written in future.
- 3.3.2.4 The introduction of this "capped 80/20" coverage is taking place with different timing and different levels of agreement depending on the lender and insurer(s) involved.
- 3.3.2.5 It is understood that a number of national UK lenders have agreed to the introduction of the revised MIG coverage for loans for which offers are made on or after 1 September 1992, with revised conditions to be negotiated later.

### 3.3.3 Revised Conditions

- 3.3.3.1 In addition to the revised coverage discussed above, MIG insurers are currently introducing revised terms and conditions for MIG for new loans.
- 3.3.3.2 The main elements being introduced cover
- (a) the linkage of the availability of the MIG product to the correct application of the lender's lending criteria,
  - (b) the provision by lenders of relevant management information,
  - (c) restricted availability of MIG for additional advances and secured personal loans,

(d) wording which eliminates all areas of the MIG product previously open to interpretation.

3.3.3.3 Lenders are currently negotiating practical terms and conditions with their MIG insurers. As a general point, lenders are unwilling to agree to wording that is wider than necessary to deliver the intent.

#### 3.3.4 Future Product Development

3.3.4.1 As the coverage and condition revisions detailed above were designed by MIG insurers with little opportunity for lenders to input to the design process, it can be expected that in future products will be developed that meet lenders' needs more fully.

3.3.4.2 The product development process will be aided by the availability of greater capacity, both for MIG covers themselves and for MIG reinsurance.

## 4. RELATIONSHIP MODELS

### 4.1 Methodology

- 4.1.1 The PLWP's first step was to investigate the causes of the current MIG experience, and so to understand the relationships between the various factors involved.
- 4.1.2 It quickly became clear that the relationships could not be adequately represented by models built on mechanical causality - eg that A causes B. Rather, the factors causing MIG claims are interrelated in a complex way requiring representation involving mutual causality, which suggests that A and B may be codefined as a consequence of belonging to the same system of circular relations.
- 4.1.3 The PLWP decided to use a methodology found in the work of Magorah Maruyama, who focuses on positive and negative feedback in shaping system dynamics. Processes of negative feedback, where a change in a variable initiates changes in the opposite direction, are important in accounting for the stability of systems. Processes characterised by positive feedback, where more leads to more and less leads to less, are important in accounting for system change. Together these feedback mechanisms can explain why systems gain or preserve a given form, and how this form can be elaborated and transformed over time.
- 4.1.4 Diagrams representing mechanical causality (A causes B) usually involve straight lines. Diagrams representing more complex systems use loops rather than lines. In the particular methodology used here, full lines denote positive feedback relationships where more leads to more and less leads to less, and dashed lines denote negative feedback relationships where changes in one direction are associated with changes in the opposite direction.

### 4.2 Models

- 4.2.1 It is the PLWP's view that the factors driving MIG experience can be divided into two broad groups.

- 4.2.2 Some factors are connected to an individual loan, an individual borrower, and an individual lender. For example, an individual loan and borrower have a particular debt service ratio, which is positively related to MIG claim frequency: the higher the debt service ratio, the greater the probability of loan default and hence MIG claim. We describe the relationships between factors in this group in our Micro Relationship Model.
- 4.2.3 Factors in the other group are connected to the general level of MIG claims. For example, the level of national house price inflation is negatively related to total MIG claim outgo: the higher the level of house price inflation across the UK, the lower the total MIG claims outgo. We describe the relationships between factors in this group in our Macro Relationship Model.
- 4.2.4 In our view the Macro Factors drive the major shifts in the scale of MIG experience, and the Micro Factors determine which individual loans will become the MIG claims that make up the total MIG experience.

#### 4.3 Macro Relationship Model

- 4.3.1 Our Macro Relationship Model is reproduced in Figure 4.3 on the following page. (A larger print version will be available as a handout at the 1992 GIRO conference.)



**Figure 4.3: Notes**

- 1. Solid lines represent positive feedback relationships, in which more leads to more and less leads to less.**
- 2. Dashed lines represent negative feedback relationships, in which more leads to less and less leads to more.**
- 3. It may be possible to group the factors into**
  - Social,**
  - Economic,**
  - Governmental,**
  - Lender.**

**4.3.2 The key points and conclusions are:**

- (a) that the central factor is the combined ability of borrowers to meet their mortgage and other outgoings,
- (b) that the recent extreme experience is due to the coincidence in time of a number of factors
  - increases in unemployment,
  - removal of double MIRAS tax break,
  - increases in mortgage interest rates,
  - a period of relatively low inflation,
- (c) that these economic variables are not capable of control by insurers or lenders,
- (d) that the factors that can be controlled by lenders are relatively few.

**4.3.3** We believe these macro factors drive the "potential catastrophe experience" of MIG.

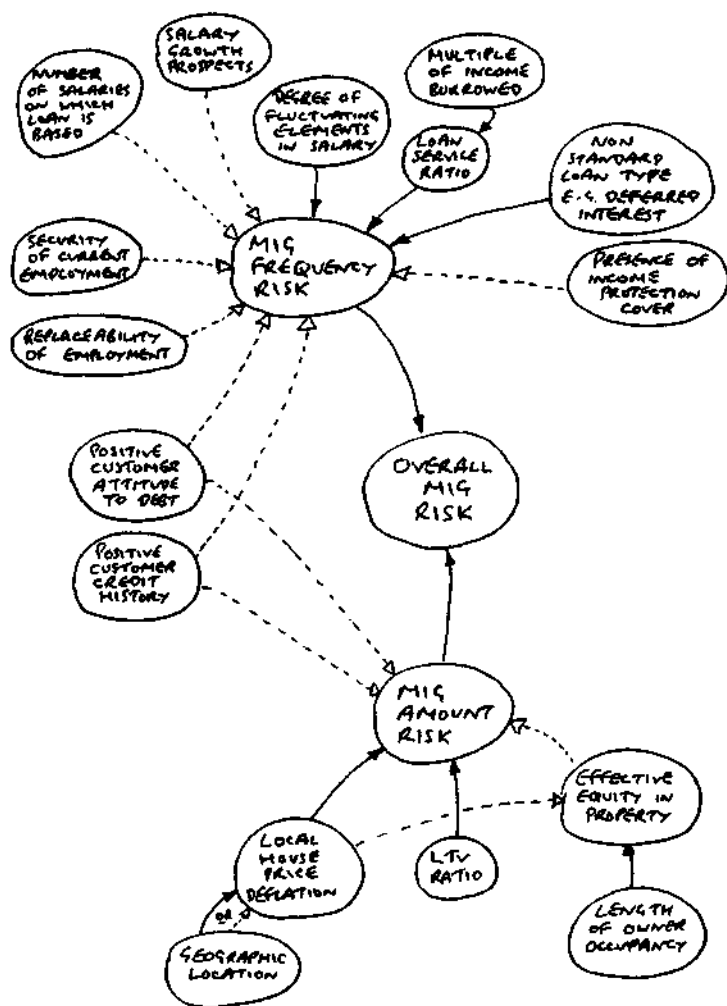
**4.3.4** In our view this model can be used as the basis for a MIG Catastrophe Warning Indicator (developed in Section 5).

**4.4 Micro Relationship Model**

**4.4.1** Our Micro Relationship Model is reproduced in Figure 4.4 on the following page. (A larger print version will be available as a handout at the 1992 GIRO conference.)



FIGURE 4.4 : MICRO RELATIONSHIP MODEL



**Figure 4.4: Notes**

- 1. Solid lines represent positive feedback relationships, in which more leads to more and less leads to less.**
- 2. Dashed lines represent negative feedback relationships, in which more leads to less and less leads to more.**
- 3. It is possible to group the factors into**
  - Income margin factors,**
  - Employment factors,**
  - Personal factors,**
  - Asset margin factors.**

- 4.4.2 It is our view that the UK economy, housing market, and mortgage market have changed significantly over the last 5 years. It is therefore not possible to construct an accurate stochastic model of future MIG experience based on past data.
- 4.4.3 However, the model describes the relationship of factors that can be related to an individual borrower. We believe these rating factors drive the "normal attrition experience" of MIG.
- 4.4.4 In our view this model can assist in providing the basis for an individual MIG rating and reserving model (developed in Section 6.).

## 5. CATASTROPHE WARNING INDICATOR

### 5.1 Description

5.1.1 Having established a Macro Relationship Model, we attempted to identify the relative "strengths" of each relationship, that is whether a given relationship within our model could be considered to be strong, medium or weak. On this basis we were able to narrow down the drivers of our Macro Relationship Model to a number of key factors as follows:-

- rate of inflation as measured by RPI,
- annual rate of change in the rate of unemployment,
- annual rate of change in the underlying mortgage rate of interest,
- maximum multiple of salary on which mortgage advances are readily and widely available to mortgage borrowers,
- maximum loan-to-value (LTV) ratio readily and widely available to mortgage borrowers,
- annual rate of change in real house price inflation,
- rate of divorce,
- average percentage of mortgage interest amounts met by tax relief.

5.1.2 The last factor highlighted above, namely the impact of tax relief on mortgage repayments, could be argued as being correlated with the mortgage rate of interest and real house price inflation. It should be noted, however, that the majority of these key factors are inter-related and that it will be inevitable that some degree of apparent duplication of economic impact will be present in identifying key economic variables.

5.1.3 A Catastrophe Warning Indicator based on such economic factors has the advantage of widespread application to

building societies, other lending institutions and insurers alike, as a direct result of its general exclusion of factors which may be specific to a given organisation. By the same token, it is also relatively straightforward to modify the values taken by those key factors which are subject to some degree of variation from one organisation to another (for example the various mortgage lending criteria) in order to attempt to reflect more closely the likely experience of the institution.

- 5.1.4 The other major advantage of such an indicator lies in the ease both with which historic data may be obtained and with which the key factors may be monitored. The factors incorporated into the model are key economic indicators or variables underlying key policy decisions of lending institutions which may be easily determined or which are widely published. Furthermore, the economic indicators are subject to a wide range of official and independent forecasts, both of a short-term and long-term nature.
- 5.1.5 Here lies the main attraction of the Catastrophe Warning Indicator. On the basis of some form of consensus forecasts of key economic indicators and anticipated industry or company-specific values for other factors, it may be possible to produce an indicator of the extent and timing of future catastrophes. In formulating such an indicator, it is inevitable that any model will be fitted in such a manner so as to attempt to reproduce the historic experience of the housing market. It must be taken into consideration, therefore, that:-
- Other new factors may emerge in the future which will have a key bearing on the outcome of the housing market.
  - The model will clearly be sensitive to the "accuracy" of the economic forecasts.
  - There will inevitably be additional economic factors which, if incorporated into the Catastrophe Warning Indicator, would result in a model more closely reflecting the historic, and hopefully future, arrears. However, the additional complications of including and monitoring further factors would detract from the simplicity and ease

of application of the model. The model should, therefore, be thought of as providing a broad indicator of the likelihood and timing of a catastrophe within the housing market, rather than predicting the precise extent of any adverse experience.

- Lending institutions and insurers have taken a more proactive role in managing arrears cases and levels of repossessions in the early 1990s. In particular, some MIG insurers have offered to pay the mortgage interest arrears of mortgages in specific instances, thereby avoiding the problem of having to pay the, typically much larger, MIG claims. The lenders themselves have increased both the speed and the depth of their involvement in arrears cases and are becoming gradually more inclined to utilise repossession only as a last resort. (The depressed house market over the late 1980s and early 1990s has resulted in significant numbers of repossessed properties yielding considerably lower resale values than original purchase prices and, indeed, mortgage advances.) Consequently, the percentages of mortgages currently falling into arrears may be artificially depressed and hence the fit of our model may be less accurate for the most recent past.

- 5.1.6 In any event, we would highlight again that this Catastrophe Warning Indicator is not intended to be commercially sensitive in that we hope that all MIG insurers and lenders will be able to derive equal benefit from it. Indeed, the model is essentially aimed at attempting to identify the timing of the potential for another wave of mortgage arrears and MIG claims as witnessed over the early 1990s, as well as attempting to highlight the key factors contributing to the current situation. Once a potential future catastrophe has been identified, it is a relatively straightforward process to investigate the sensitivity of the model to those variables where insurers or lenders have the ability to exercise some degree of control now (eg lending criteria), and thereby identify various evasive actions which could be implemented now in order to avert that potential catastrophe at some later point in the future.

## 5.2 Progress to Date

5.2.1 The construction of the Catastrophe Warning Indicator required us to attempt to determine, for each of the key factors identified in paragraph 5.1.1 above, both the nature of and the relative magnitude of their impacts on levels of mortgage arrears (as measured by the percentage of all in-force mortgages in arrears of 6-12 months). In designing our model we utilised three main criteria, namely that:-

- the model should be objective, that is operate on a set of pre-determined algorithms,
- the model should be relatively simple and be easily fitted to historic data,
- the model should, if possible, attempt to take into account any interactions between the various key factors.

5.2.2 In designing the Catastrophe Warning Indicator, a number of possibilities were considered for the nature of the output, including the following:-

- numbers (or proportion) of arrears cases,
- numbers (or proportion) of repossessions,
- average values of MIG claims (revalued to present monetary values),
- average amount of mortgage interest arrears (again revalued to current monetary values).

We elected to utilise the proportion of all in-force mortgages which have fallen into arrears of between 6-12 months at a given point in time as being the index for the Catastrophe Warning Indicator, largely as a result of our intention that the model should operate on the basis of relativities. In particular, this implied that the model should not need to incorporate additional information relating to extraneous factors other than those incorporated into our model. If we had wanted instead to utilise the numbers of arrears cases of between 6-12 months for the model's

index, we would have needed to incorporate some factor to take account of changes in the absolute volumes of in-force mortgages. By considering the proportions of all in-force mortgages, we can effectively restrict the number of variables within the model to the minimum, that is to the key factors only.

5.2.3 The Catastrophe Warning Indicator does not, therefore, provide any indication of the monetary magnitude of a potential catastrophe, either to lenders or to MIG insurers. It does, however, aim to provide an indication of the severity of potential upturns in arrears cases in (relative) frequency terms. Consideration of the forecast relative frequencies in the light of numbers of mortgages in force and the average projected costs of arrears cases (which may well be unique to each lender or MIG insurer) would then provide some indication of the potential financial impact of a given scenario.

5.2.4 In attempting to identify both the nature of the influence that each of our key factors exerted on the proportions of mortgages in arrears and the relationships between each of the factors, three main types of mathematical model were considered as follows:-

- **Additive models** - such that each factor contributes its own independent effect, possibly in addition to some interactive or correlative effects.
- **Multiplicative models** - whereby the component factors have a multiplicative effect on each other such that all the factors are somehow correlated.
- **Matrix-type models** - such that the magnitude of the correlations of any one factor to each of the remaining factors can be identified by means of a matrix. Multiplying this matrix with another matrix comprising scalars and taking the determinant of their product would then produce an indication of the overall impact of the selected factor combinations. This form of model is, in effect, an extension of the additive model outlined above. An iterative method could be utilised to identify the parameters and scalars "of best fit".



5.2.5 We elected to utilise an additive model which did not attempt to identify explicitly the effects of correlations between each of our selected key factors. Whilst we recognise that very strong correlations exist between the factors identified, for example between rates of interest and underlying levels of inflation or between house price inflation and retail price inflation, our approach could be interpreted as having allowed for correlations in an implicit manner via:-

- the choice of weights within weighted averages,
- the scalars applicable to each variable, and
- the use of real data (ie net of underlying inflation) in some instances.

Our model is of the form:-

$$Y_t = x_1A_t + x_2B_t + x_3C_t + x_4D_t + x_5E_t + x_6(1/F_t) + x_7(1/G_t) + x_8H_t - z$$

where:-

$Y_t$  = the proportion of all in-force mortgages which are in arrears of between 6 to 12 months of interest payments at the end of calendar year  $t$ ,

$x_1, x_2, x_3, x_4, x_5, x_6, x_7, x_8$  and  $z$  are scalars,

$A_t$  = the average rate of inflation, as measured by RPI, over calendar year  $t$ ,

$B_t$  = the average rate of change in the rate of unemployment over calendar years  $t, t-1$  and  $t-2$ ,

$C_t$  = a weighted average of the rate of change in mortgage rates of interest over calendar years  $t, t-1$  and  $t-2$ ,

$D_t$  = a weighted average of the maximum multiples of earnings on which mortgages were generally advanced over calendar years  $t, t-1$  and  $t-2$ ,

$E_t$  = a weighted average of the maximum loan to value ratio on which mortgages were generally advanced over calendar years  $t$ ,  $t-1$  and  $t-2$ ,

$F_t$  = the average rate of house price inflation over calendar years  $t$  and  $t-1$ ,

$G_t$  = the average percentage of mortgage interest met by income tax relief over calendar years  $t$  and  $t-1$ ,

$H_t$  = the average rate of divorce over calendar years  $t$  and  $t-1$ .

5.2.6 We utilised historic data over the period 1982 to 1991 inclusive in fitting our model. Our intention was to attempt to fit our model to both conditions of "attritional" arrears experience as exhibited over the mid-1980s and the deterioration witnessed over the early 1990s in order to arrive at a reasonably robust indicator of the mortgage arrears climate. We utilised the following sources of information, for which data was generally available as at the end of each calendar year:-

- divorce rates - Office of Population Censuses and Surveys,
- RPI - International Financial Statistics Yearbook,
- (real) house price inflation - Social Trends 22,
- mortgage rates of interest - Building Societies Commission,
- rate of unemployment - Department of Employment (DoE),
- percentage of total mortgage interest met by tax relief - Council of Mortgage Lenders,
- percentage of mortgages 6-12 months in arrears - Council of Mortgage Lenders.

- 5.2.7 As some of the available data was only available in graphical format, consistency in the interpretation of such information may not necessarily have been attained. We therefore recognise that the source data utilised in the fitting of our model may be approximate in certain instances, but we nonetheless believe that we have been able to establish at least a solid basis for the further development of such a Catastrophe Warning Indicator. Our intention is to develop the model further (and obviously to establish the correct historic data values from non-graphical sources as appropriate), to include some, or possibly all, the refinements as discussed in paragraph 5.3.2 below.
- 5.2.8 In fitting our model, we have adopted a somewhat less than scientific approach. Rather than use an iterative method working towards a sum of least squares, we approached the model-fitting process with the initial aim of attempting to establish whether or not a fit of any description was possible. We attempted to quantify the relative degrees of influence on the market's arrears experience attributable to each of our key factors through an essentially qualitative approach. In particular, we considered a variety of scenarios which had, in practice, given rise to arrears cases and utilised the backgrounds to each of these cases in order to gain an understanding of the main causes for the lapse into mortgage interest arrears. This form of analysis was crucial to selecting the time frames over which weighted averages of data values were to be calculated. For example, there appears to be a significant lag following substantial increases in the mortgage rate of interest before the proportion of mortgages in arrears starts to climb. This particular phenomenon can be explained, in part, by the short-term use of personal savings and the taking on of second jobs by mortgage holders in instances where finances had already been stretched at the point of mortgage advance.
- 5.2.9 Once some semblance of a workable model started to emerge, the closeness of fit of the model was refined by way of trial and error, within the context of both the values of the scalars (which represent the relative magnitudes of the impact of each factor) and the weights used within the

calculations of the various weighted averages. The model was constructed as a spreadsheet, which lent itself readily to a trial and error approach, and utilised a square of residual terms indicator in order to assist with the fitting process.

- 5.2.10 Our full results are shown in Appendix A2. The table below shows our fitted values against the actual proportions of mortgages 6-12 months in arrears at the end of each of calendar years 1984 to 1991 inclusive.

Percentage of mortgages 6-12 months in arrears at end of:

	1984	1985	1986	1987	1988	1989	1990	1991
Actual	0.66	0.74	0.67	0.67	0.50	0.73	1.31	1.68
Fitted	0.64	0.76	0.65	0.62	0.56	0.80	1.25	1.68
Residual	0.02	-0.02	0.02	0.05	-0.06	-0.07	0.06	0.00
% error	3.0	2.7	3.0	7.5	12.0	9.6	4.6	0.0

- 5.2.11 The results in the above table indicate a reasonably close fit over the period under consideration. Whilst the percentage tracking error of the model over the period 1987-1989 is significantly higher than witnessed elsewhere, the fitted values do nonetheless duplicate the shape of the graph of the actual experience over time surprisingly well, giving us some degree of confidence in the robustness of the model. In particular, we have been able to duplicate, at least in broad terms, the extremities witnessed in the UK housing market over the period analysed, thereby enforcing our belief that a Catastrophe Warning Indicator is a feasible proposition and, indeed, may have useful practical applications.

### 5.3 Next Steps

- 5.3.1 We would be the first to acknowledge that the Catastrophe Warning Indicator in its current state is far from sophisticated in its construction and application. We recognise, in particular, that the model is weak in at least the following areas:-

- The fitting of the model to historic data.
- The accuracy and interpretation of historic data sources, particularly in respect of the 1991 year-end where the majority of available data are best estimates of the position at the end of the 1991 calendar year.
- We have not attempted to allow explicitly for the correlations which are thought to exist between our key factors.
- The number of the factors incorporated into the model may well be excessive. In particular, the effects of certain of the factors (for example, the rate of retail price inflation) has a relatively small degree of influence on the results of the model. Changes in mortgage rates of interest, another factor in the model, might already be thought of as indicative of underlying rates of inflation as the UK Government utilised mainly monetarist policies to control (or attempt to control) inflation over the period of time analysed.

5.3.2 We would welcome comments and suggestions at the GIRO conference for the development and refinement of the model both in general terms and along more specific lines as follows:-

- fitting the model (including computerised iterations),
- type of model considered most suitable (additive, multiplicative, matrix or other),
- factors for inclusion/exclusion,
- other approaches for "calculating" the impact of each key factor,
- econometric models,
- economic forecasting (ie rather than relying on external sources, economic variables such as consumer price inflation could be modelled).

We would, of course, welcome specific suggestions along other lines, including the abandonment of future work in connection with a Catastrophe Warning Indicator!

5.3.3 Notwithstanding the above, what needs to be established is whether or not there is any practical value in continuing to develop a Catastrophe Warning Indicator and, if so, to what applications can the model be put? Our own thoughts in this area are summarised below, but again we would welcome suggestions and comments. Our own suggestions include the following possibilities:-

- a model to assist mortgage providers in the establishment of bad or doubtful debt provisions,
- a model to assist MIG insurers in the reserving process for this class of business,
- a generalised MIG rating model if used in conjunction with forecasts of numbers of mortgages and average costs of arrears and MIG claims.

5.3.4 Clearly, the Catastrophe Warning Indicator in its existing form is not suitable for use as a premium rating model in that it does not allow for:-

- specialised mortgage products such as fixed interest rate loans for a known period of time,
- local branch manager discretion in granting mortgage advances on non-standard lending criteria,
- the characteristics of each individual borrower or borrowers under a specific mortgage in terms of the multiple of income advanced, loan-to-value ratio of mortgage, occupation, geographical location of the property purchased, etc.

5.3.5 In respect of the last point in the above paragraph, it would be a relatively straightforward task to utilise house price inflation and unemployment data specific to each geographical location in attempting to assess the outturn for each such area. The next section of this paper goes

further than this and discusses a premium rating and reserving model which is based on the characteristics pertaining to each individual mortgage and which derives, in principle, from our Micro Relationship Model.

- 5.3.6 The PLWP has had little opportunity to date to persuade MIG insurers to participate in the development of either the (macro) Catastrophe Warning Indicator or the (micro) premium rating and reserving model. This may have been attributable, in part, to the reluctance of insurers to become involved in the PLWP in the belief that their own data, their own MIG claims experience or their own approaches would have been made public. It is also possible that insurers were already content that their own such models, if these were being developed, were satisfactory or that they may have been unprepared to see the product of their expenditure on the design and implementation of such models utilised for research purposes.
- 5.3.7 We hope that our own progress with a premium rating and reserving model and the development of our Catastrophe Warning Indicator will encourage mortgage lenders and MIG insurers alike to participate in the refinement of such models. The pooling of resources and ideas for the development of models with far-reaching practical applications is, in our opinion, the most logical and economical way forward and will, hopefully, provide some degree of benefit to all contributors. We would highlight again that the Catastrophe Warning Indicator is a generalised model and its modification is not, therefore, commercially sensitive. It is, as such, intended to benefit all mortgage lenders and MIG insurers equally. Once refined and considered to be suitably robust, the model can be tailored to each specific user by simply applying the model to the data subset deemed to be most appropriate to that organisation.

## **6. PREMIUM RATING AND RESERVING MODEL**

**6.1** After some discussion within the PLWP, we decided to abandon the stochastic approach used in 1991. The result is the deterministic model reproduced in Appendix A3, in which the sequence of economic events is taken as given. This could be either generated by an economic model, which could be incorporated as the first part of a two-stage process, this being the second part, or else these could be specified by the user. The point of this would not necessarily be to generate predictions or "best estimates", but to answer questions such as:

- what premium would be sufficient for this (possibly extreme) future economic/social environment?
- what reserves will we need if the future environment is as we specify?

**6.2** The model which we have built uses a pre-specified economic/social environment. This has no significance in the outside world - the actual values chosen were invented simply to allow the model to be tested and illustrated. To this end some fairly extreme assumptions were used. At first, prices rise rather faster than wages - which are assumed to fall. This puts an initial squeeze on incomes, but as the nominal rise in prices is small there is little rise in house prices. After a year interest rates are raised, then three months later taxes are raised, although the tax deductibility of mortgage interest is made more generous. The result is that at its nadir, after 24 months, the borrower's take-home pay after mortgage commitments has less than 70% of its original purchase power.

**6.3** A probabilistic trigger has been used to simulate the numbers of mortgages defaulting. There are assumed to be three causes of default. These are unemployment, divorce and loss of disposable income. The numerical values assumed are of no significance - the probability is generated in a subroutine in the programme which could easily be altered for any other specified set of relationships. The probabilities used for illustration have been assumed to be independent and additive, and are:-



- Unemployment has been assumed to have a cyclical pattern, based on a sine curve, repeating over seven years. This ought to be linked functionally to the other economic variables, but this is really part of the economic part of the model. Without doubt the approach which has been used is not realistic.
  - The probability of a default from lack of income in any month is assumed to double with every 10% lost income, and to be 100% when all income is lost.
  - It is assumed that 0.06% of all mortgagors get divorced each month, and that half of these cases result in default.
- 6.4 The amount of the insurance claim is based on the new type of contract introduced in the UK earlier this year. This may result in a large proportion of the loss being borne by the lender, especially when house prices have fallen drastically.
- 6.5 With the nature of the assumptions, the results themselves have no importance, and we have shown them simply to illustrate the framework. More work needs to be done not only in projecting an economic framework but also in researching the relationship between the economic variables and the incidence of defaults. In the end these are judgemental decisions rather than analysable facts. As seen above, the relationships are very complicated, and we need to decide which are the most important relationships which have to be included, what is the form of the relationship, and what the parameters are. However, the strength of the framework is that we can test a large number of initial variables for their effect on the final answers - not only the loan to value relationship, but the loan service costs as a proportion of pay, the mortgagor's gross income as a proportion of the mortgage, and other such differentiating factors which undoubtedly play a part in the risk but which are currently ignored in underwriting this type of insurance in the UK.
- 6.6 Further steps will be to define the relationships. This may well lead to a restatement of the framework. A strong arithmetical link may be found between unemployment and the other economic factors, or it may not. If not, then the existence in the current framework of unemployment as an independent factor may be justified, even though it has been included merely as an interim expedient. In any case, the rate of unemployment is not the same thing as the

probability of becoming unemployed, and this should also be considered when trying to upgrade the model. Almost all the other relationships included are subject to the same type of considerations.

- 6.7 Although the results themselves are of no importance, the values chosen do illustrate one notable fact. Default in the first month of the contract causes loss of over £25,000. This does rely on some assumptions we made about how long it takes for property to be sold after default and how much the fixed expenses of the sale are likely to be, but we believe the assumptions made (two years and £5,000 respectively) are realistic. As this is the first month of the contract, it is barely affected by the economic variables assumed. This illustrates that loss may be substantial even with a significant margin - we have taken 7% for illustration - at the outset between the loan and the value of the collateral property.
- 6.8 Feedback is sought from the 1992 GIRO conference on whether further work on such models will be useful. It is possible that models at this level will be regarded as commercially sensitive and that different MIG insurers will wish to develop their own particular models. Alternatively, there may be merit in refining the model so that it can be used as a standard mechanism into which insurers will input their own choice of economic variables.

## **7. NEXT STEPS**

### **7.1 Feedback**

The PLWP requests detailed feedback from the 1992 GIRO conference on the work done to date.

### **7.2 Direction**

The PLWP needs to develop a clear understanding of what further work will be useful, both for MiG and other product lines.

### **7.3 Other Products**

In the PLWP's view much of the recent work on MiG has relevance to other product lines, in particular those products, such as Creditor, whose financial performance is in some way related to economic factors.

## **APPENDICES**

### **A1. Overseas Practice**

- US,
- Europe,
- South Africa,
- Australia/New Zealand,
- Japan.

### **A2. Catastrophe Warning Indicator Model**

- details and full results.

### **A3. Premium Rating and Reserving Model**

- details and full results.

## APPENDIX A1

### OVERSEAS PRACTICE

#### Introduction

MIG is a component of relatively sophisticated mortgage markets and therefore is present in relatively few countries. This note highlights the key elements of MIG in the US, Canada, Europe, South Africa, Australia, New Zealand and Japan.

## US MIG PRACTICE

Standard US practice is for the MIG insurer to "underwrite" the loan. The lending institution originates the loan and in return for that obtains an origination fee (typically 1%). Any further involvement is confined to servicing for which there are basic service fees and excess service fees. However, at some point most or all of a lender's loans will be securitised and sold on. This practice enables lending institutions to operate on very low capital.

In common US practice, the MIG insurer will support many lenders. The MIG product is needed to enable securitisation to take place, as otherwise the mortgage pool insurance is not available. Mortgage pool insurance therefore provides an excess layer on top of individual MIG covers. This practice is standard throughout the industry because the main buyers of securitised loans require it to be so (the US government sponsored agencies Fannie Mae and Freddie Mac buy 70% of such loans).

The typical US MIG insurer will rate business according to property type (detached, terraced, etc), construction type (timber frame, stone), position and location, loan to value, individual customer credit rating, and individual customer credit history.

US practice includes a range of MIG products including

- MIG by annual premium,
- MIG with and without a refund to the customer on moving house,
- short term MIG in which the lender has the choice of the period of MIG cover, this period being much shorter than the term of the mortgage, for example a five year MIG on a 25 year mortgage, with an option for the lender to exercise to extend the cover.

It is common practice for MIG insurers to take steps early in the process to reduce total claims outgo. Such "delinquent loss mitigation" involves making staged payments to prevent arrears becoming excessive. If there is an eventual full MIG claim then any such staged payments would be treated as partial claim payments which had been made early and will thus reduce the final MIG claim amount.

The MIG insurer's rights of subrogation vary by state. In some states it is possible for the insurer to pursue the borrower for all loans, in some states only on loans covering secondary residences, and in other states not at all.

US MIG insurers may only write MIG. This has the effect of building specialist expertise - the MIG insurer's financial performance results only from its management of its MIG business, and cannot be supported by profits from other product lines.

Note: An excellent summary of mortgage securitisation in the US appeared in the Economist on 15 August 1992.

## CANADIAN MIG PRACTICE

In the Canadian mortgage insurance market 70% of lenders insure through the Canada Mortgage Association, which is State run, and the other 30% insure through the private company of The Mortgage Insurance Company of Canada, who were founded in 1964.

MICC made a net profit of \$3.5m in 1991 and \$64m was paid out in claims, \$35m of which accounted for residential properties.

MICC write in all provinces, with the exception of Alberta. In Alberta mortgages do not have a repayment covenant, and therefore when individuals experience problems with their mortgages, they can simply "walk away". Consequently, MICC lost on 20% of the policies they wrote in Alberta and have thus withdrawn from the province.

The Canadian market is aided by a couple of factors:

1. Fluctuating interest rates are not an issue since all mortgages are fixed rate.
2. There is no limit on housing stock - the Canadians are building all the time. Historic building classification can apply to a building erected in 1910.

The Canadian mortgage market is very standardised, with banks carrying out all the mortgage lending. Furthermore, there are only five major banks in Canada.

MICC approve the lenders they write for and have established procedures. They supply lenders with a lending guide but do not dictate lending terms.



## USAGE OF MIG IN EUROPE

### Introduction

Experience differs from country to country but seems to fall into 5 groupings:

- i) no insurance at all,
- ii) the whole loan being insured,
- iii) the amount of the loan exceeding a set percentage of the valuation of the property being insured (eg UK),
- iv) borrowers being required to contribute separately to a reserve fund to cover losses (eg Denmark),
- v) borrowers being required to provide guarantors (eg France and Germany).

The manner in which any insurance is effected can also differ between countries. The Danish effectively use a self-insurance system, whereas in the UK the large insurance companies at present undertake "top slice" insurance.

There now follows a review of systems used in each country.

#### 1. Belgium

The closest thing to a mortgage insurance system is the credit insurance which some companies use.

It has not been successful as the cost has been reflected in the interest rate and insurers have tried to interfere with lending criteria.

Credit insurance normally consists of an "open" or whole turnover policy to cover all the business handled by the lender. Specific risks, however, can be insured.

Usually a cover rate threshold is set at which the lender is required to submit the file to the insurer. The insurer then conducts his own investigation into creditworthiness, track record in honouring financial commitments and a further appraisal of the mortgaged property and its environment.

Cover is provided up to the time when the LTV has reduced to a percentage where the lender feels that he can accept the whole risk.

In the absence of credit insurance, various guarantees are used on high LTV mortgages. These can range from third party personal guarantees to the domiciliation of income on an account held by the lender.

Normal LTV is from 60% to 80% of the value of the property in the event of a voluntary public sale.

## 2. Germany

There are no mortgage insurance schemes as German credit institutions and insurance companies dislike the cover of such risks, probable losses being difficult to calculate.

It is also understood that insurers do not like the idea of bearing significant portions of the lending risk.

Bank guarantees are used as lenders cannot advance more than 80% without additional collateral being provided.

Some Bausparkassen cooperate with specialist institutions and act as intermediaries for guarantees.

A fee of around 1% of the guaranteed top slice of the loan is charged, and this guarantee then works exclusively for the lender.

The guarantor may also have recourse to the borrower.

## 3. Denmark

Lending in Denmark is highly regulated, and this type of cover is provided for by lenders having a reserve requirement.

Reserves must be held worth 5% of the volume of bonds in circulation upon which the loan is based. This is met by the borrower paying, on a loan with a currency of 20-30 years, an upfront payment of 1% of the principal and a contribution of 2% of the quarterly or semi-annual instalment.

Interest of between 8% and 10% before tax is paid on to the reserve requirement for each loan. This ensures that the reserve is accumulated over a period of about 9 years.

This scheme avoids the 50% taxation on mortgage credit institutions which has been in place since 1987.

4. Spain

There is very little insurance of loans in Spain as loans are normally only 70-75% of the property value.

Great store is held in ensuring the properties involved are prudently and correctly valued, and Spanish mortgage law then insists that appropriate "loss insurance" is taken out if the loan is greater than the normal LTV ratio. No further information is available on this "loss insurance".

5. France

Mortgage guarantee insurance is not used in France. The lenders can require:

- i) a mortgage security on the property subject to the loan,
- ii) a mortgage security on another property belonging to the borrower,
- iii) the joint guarantee of one or more persons,
- iv) the mortgage guarantee of one or more persons.

6. Greece

Again there appears to be no need for this type of insurance as the maximum LTV is 50%.

7. Italy

The main supplementary guarantees used are:

- i) a guarantee from a credit institution which guarantees payment of instalments or the principal,

- ii) an insurance policy for a single premium for the amount over 50% of the building cost - these policies oblige the lender to begin proceedings upon non-payment of two or three instalments,
- iii) a pledge of goods or valuables owned by the borrower or by a third party.

## 8. Norway

Once more bank guarantees are the norm and actual mortgage insurance usage is declining.

Norwegian lenders do not normally advance more than 80% of the value of the property. If more is requested then a bank or personal guarantee is needed. Personal guarantees usually come from the parents of the prospective borrowers.

Bank guarantees are normally in the form of personal surety so that the lender can recover from the guarantor immediately repayment is overdue, even if it is only one payment.

Credit insurance is sometimes still used for larger loans. In these cases the lender does the administration and informs the insurer which loans are insured. Insurers must be notified within 90 days if there is default on payments.

## 9. The Netherlands

There are two types of insurance, although details are currently sketchy:

- i) Mortgage Interest Insurance - most lenders have this insurance, which apparently covers the actual risk of mortgage lending,
- ii) Topslice Insurance - this insures the lender's total portfolio against all risks of not getting repayment on the mortgage for the top slice of the loan (eg above 100% of the foreclosure value).

#### 10. Portugal

No mortgage guarantee insurance is used as such. When cover is requested by a lender, it is written by insurance companies on an individual basis.

The debtor may change or cancel this insurance which may be updated, whenever the financing entity requires it.

#### Conclusion

There are a variety of methods used in Europe for covering the risk of default. A definite trend seems to be emerging.

Amongst the more sophisticated northern European countries there appears to be a move away from insurance of such risks and towards the building of reserves and obtaining various forms of bank and personal guarantee.

Major factors within continental lending policy that allow the use of this type of guarantee are:

- i) the amount of lending for house purchase,
- ii) the amount of high LTV lending.

The UK mortgage market has a greater proportion of high LTV lending than our continental neighbours and many countries do not have the same attitude towards owning their own home (eg France and Germany) as prevails in the UK.

## MIG PRACTICE IN AUSTRALIA AND NEW ZEALAND

The great majority of MIG business is written by three companies:

- Housing Loans Insurance Corporation (HLIC),
- MGICA,
- CU Australia Mortgage Insurance Corporation.

Other general insurers write a small amount of MIG business. Two companies write only in New Zealand.

HLIC was established in 1965 as a statutory corporation guaranteed by the Commonwealth Government, however it is due to be sold.

The volume of loans insured fell by over 50% between 1988 and 1990.

Lending in Australia is controlled by the Housing Loans Insurance Act 1965-66.

## MIG PRACTICE IN JAPAN

In summary, the standard MIG contract is not much known in Japan. Mortgage insurance is small and, if provided, is generally available through the specialised subsidiary of the mortgage lender (usually a bank).

The pattern of mortgage borrowing is different to that in the UK. Most employees have access to some housing loan through their employer and there are then public utilities which provide further funds. Only for unusual loans would a customer need to borrow from the commercial sector, ie the banks.

Insurers are not really involved - lenders cover their own lending risks.

CATASTROPHE WARNING INDICATOR  
FIT OF MODEL TO HISTORIC DATA : FULL RESULTS

Historic data @ end of calendar year

	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991
RPI	11.90	8.60	4.50	5.00	6.00	3.40	4.20	4.90	7.80	9.50	6.5
% of workforce unemployed	X										
Rate of change in unemployment	X	10.5	12.75	13.5	13.75	14	12.25	9.5	7	6.7	9
Mortgage interest rates	X	-21	-06	-00	-02	.02	-.13	-.22	-.26	-.04	-.34
Rate of change in mortgage rates	X	15.00	10.00	11.30	12.00	12.80	12.30	10.30	12.60	14.40	14.50
Max salary multiple available	X	-33	-13	-08	.07	-.04	-.16	-.24	-.13	-.01	-.16
Max LTV ratio available	X	3.5	3.5	3.5	3.5	3.5	3.5	4	4	3.5	3.5
House price inflation/(deflation)	X	95	95	95	95	95	95	100	100	95	95
Rate of change in house price inflation	X	4.5	2.75	12.5	7.5	9.5	11.5	16	24.25	21.5	-.5
% of mortgage interest met by tax relief	X	-39	3.55	-.40	.27	.21	.39	.52	-.11	-1.02	3.00
Divorce rate	X	30	28	28	28	26.3	24.7	23	21	19	17
		1.01	1.05	1.1	1.01	1.14	1.28	1.13	1.13	1.14	1.19
Mortgage arrears 6-12 mths (%) - actual		.42	.43	.66	.74	.67	.67	.5	.75	1.31	1.68
Mortgage arrears 6-12 mths (%) - fitted				.64	.76	.65	.62	.56	.80	1.25	1.68
Difference (actual - fitted)				.02	-.02	.02	.05	-.06	-.07	-.06	.00





The following pages reproduce the simulation's spreadsheet in the following order:-

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On each page the month of simulation is shown in the first or last column.

Month	Annual per cent real rise in		Latest		Latest post		Latest		Default now would give:.....	
	Prices	Wages	Current	take home	mortgage income	as pc of	house	value	Amount of Two years' Excess	mortgage interest
	(£)	(£)	Salary	pay (£)	(£)	original	(£)	(£)	(£)	(£)
1	2.500	-1.003	25030.46	1430.69	650.24	100.03	99778	93000	17218	5010
2	2.495	-0.992	25061.08	1432.22	651.77	100.06	99557	93000	17218	5021
3	2.502	-1.005	25091.61	1433.75	653.30	100.09	99337	93000	17218	5031
4	2.497	-0.994	25122.31	1435.28	654.84	100.12	99117	93000	17218	5041
5	2.504	-1.007	25152.92	1436.81	656.37	100.14	98897	93000	17218	5052
6	2.499	-0.996	25183.69	1438.35	657.90	100.17	98679	93000	17218	5062
7	2.506	-1.008	25214.38	1439.89	659.44	100.20	98460	93000	17218	5073
8	2.500	-0.997	25245.22	1441.43	660.98	100.23	98242	93000	17218	5083
9	2.495	-0.998	25275.99	1442.97	662.52	100.25	98024	93000	17218	5093
10	2.502	-0.999	25306.91	1444.51	664.07	100.28	97808	93000	17218	5104
11	2.497	-1.000	25337.75	1446.05	665.61	100.31	97591	93000	17218	5114
12	2.504	-1.001	25368.75	1447.60	667.16	100.33	97375	93000	17218	5125
Interest rate change !										
New rate 11.021 per cent per annum										
New mortgage repayment £785.21										
13	1.461	-2.006	25356.59	1447.00	540.89	81.25	96641	93000	20498	5131
14	1.460	-1.997	25344.59	1446.40	540.28	81.06	95911	93000	20498	5137
15	1.470	-2.000	25332.73	1445.80	539.69	80.87	95188	93000	20498	5144
Tax structure is:										
There are 6 different rates										
Mortgage interest relief is given at 25.0 per cent up to £250000 mortgage.										
Tax band 1 finishes at £ 4000 and is taxed at 9.00 per cent										
Tax band 2 finishes at £ 5000 and is taxed at 29.00 per cent										
Tax band 3 finishes at £ 10000 and is taxed at 34.00 per cent										
Tax band 4 finishes at £ 20000 and is taxed at 40.00 per cent										
Tax band 5 finishes at £ 30000 and is taxed at 45.00 per cent										
Tax band 6 finishes at £399999 and is taxed at 50.00 per cent										

Recover To give Shared between					Default probability per cent is:			Of 10,000	
Total 90 pc cost of value					Arising from			Total Repay Def:	
					Divorce Income Unemp				
					loss ment				
								Month	
(£)	(£)	(£)	(£)	(£)					
115228	89800	25428	18000	7428	0.03000	0.09746	0.12180	0.24927	82
115238	89602	25637	18000	7637	0.03000	0.09726	0.11874	0.24600	81
115249	89403	25845	18000	7845	0.03000	0.09707	0.11584	0.24291	80
115259	89205	26054	18000	8054	0.03000	0.09688	0.11311	0.23999	80
115269	89007	26262	18000	8262	0.03000	0.09669	0.11056	0.23725	79
115280	88811	26469	18000	8469	0.03000	0.09650	0.10818	0.23468	78
115290	88614	26676	18000	8676	0.03000	0.09632	0.10597	0.23229	77
115301	88418	26883	18000	8883	0.03000	0.09614	0.10392	0.23005	76
115311	88222	27089	18000	9089	0.03000	0.09596	0.10203	0.22798	75
115322	88027	27294	18000	9294	0.03000	0.09577	0.10029	0.22607	75
115332	87832	27500	18000	9500	0.03000	0.09560	0.09871	0.22431	74
115343	87637	27705	18000	9705	0.03000	0.09542	0.09728	0.22270	73
118629	86977	31652	18000	13652	0.03000	0.33832	0.09598	0.48430	72
118636	86320	32316	18000	14316	0.03000	0.36302	0.09483	0.48785	71
118642	85670	32972	18000	14972	0.03000	0.36776	0.09380	0.49157	70

16	1.468	-1.952	25321.03	1381.38	475.27	71.13	94471	93000	20498	5150
17	1.454	-2.007	25308.71	1380.82	474.70	70.96	93759	93000	20498	5156
18	1.464	-1.998	25296.80	1380.27	474.16	70.79	93051	93000	20498	5162
19	1.463	-2.002	25284.79	1379.72	473.61	70.63	92349	93000	20498	5169
20	1.473	-1.993	25273.18	1379.19	473.08	70.46	91654	93000	20498	5175
21	1.459	-2.008	25260.95	1378.63	472.52	70.29	90962	93000	20498	5181
22	1.457	-2.009	25248.89	1378.07	471.96	70.12	90276	93000	20498	5187
23	1.467	-2.003	25236.97	1377.53	471.42	69.96	89595	93000	20498	5194
24	1.465	-1.994	25225.20	1376.99	470.88	69.79	88920	93000	20498	5200
25	2.988	0.496	25295.53	1380.21	474.10	70.11	89718	93000	20498	5212
26	2.881	0.508	25366.18	1383.45	477.34	70.42	90522	93000	20498	5225
27	2.885	0.496	25436.86	1386.69	480.58	70.73	91334	93000	20498	5237
28	2.890	0.495	25507.83	1389.94	483.83	71.04	92153	93000	20498	5250
29	2.883	0.507	25579.11	1393.21	487.10	71.35	92980	93000	20498	5262
30	2.877	0.495	25650.18	1396.47	490.36	71.66	93812	93000	20498	5274
31	2.893	0.507	25722.05	1399.76	493.65	71.97	94654	93000	20498	5287
32	2.886	0.494	25793.71	1403.04	496.93	72.27	95503	93000	20498	5300
33	2.879	0.507	25865.68	1406.34	500.23	72.58	96359	93000	20498	5312
34	2.884	0.494	25937.68	1409.64	503.53	72.89	97224	93000	20498	5325
35	2.888	0.506	26010.24	1412.97	506.86	73.19	98095	93000	20498	5337
36	2.882	0.494	26082.59	1416.29	510.17	73.50	98975	93000	20498	5350

118548	85024	33524	18000	15524	0.03000	0.72338	0.09291	0.84529	70
118549	84383	34272	18000	16272	0.03000	0.73094	0.09214	0.85308	68
118550	83746	34914	18000	16914	0.03000	0.73847	0.09149	0.86096	67
118551	83114	35552	18000	17552	0.03000	0.74612	0.09096	0.86908	66
118552	82488	36185	18000	18185	0.03000	0.75374	0.09054	0.87728	65
118553	81866	36813	18000	18813	0.03000	0.76162	0.09023	0.88585	64
118554	81249	37437	18000	19437	0.03000	0.76952	0.09003	0.89456	63
118555	80636	38056	18000	20056	0.03000	0.77750	0.08994	0.90343	62
118556	80028	38670	18000	20670	0.03000	0.78549	0.08994	0.91243	61
118557	79426	39284	18000	21284	0.03000	0.79358	0.09004	0.92161	60
118558	78823	39893	18000	21893	0.03000	0.78167	0.09023	0.93092	59
118559	78221	40503	18000	22503	0.03000	0.78976	0.09052	0.94037	58
118560	77620	41113	18000	23113	0.03000	0.79785	0.09089	0.94995	57
118561	77020	41723	18000	23723	0.03000	0.80594	0.09134	0.95963	56
118562	76421	42333	18000	24333	0.03000	0.81403	0.09188	0.96945	55
118563	75822	42943	18000	24943	0.03000	0.82212	0.09249	0.97945	54
118564	75223	43553	18000	25553	0.03000	0.83021	0.09317	0.98956	53
118565	74624	44163	18000	26163	0.03000	0.83830	0.09391	0.99982	52
118566	74025	44773	18000	26773	0.03000	0.84639	0.09472	0.76432	51
118567	73426	45383	18000	27383	0.03000	0.85448	0.09558	0.75169	50
118568	72827	45993	18000	27993	0.03000	0.86257	0.09650	0.73953	50



107459	89206	18253	14603	3651	0.03000	0.01066	0.09747	0.13813	49	37
107455	89335	18120	14496	3624	0.03000	0.01063	0.09849	0.13912	48	38
107451	89463	17987	14390	3597	0.03000	0.01060	0.09955	0.14015	48	39
107446	89592	17854	14283	3571	0.03000	0.01057	0.10066	0.14123	48	40
107442	89721	17721	14177	3544	0.03000	0.01054	0.10182	0.14236	47	41
107438	89851	17587	14070	3517	0.03000	0.01051	0.10304	0.14355	47	42
107434	89980	17454	13963	3491	0.03000	0.01048	0.10432	0.14489	46	43
107430	90109	17321	13857	3464	0.03000	0.01045	0.10569	0.14614	46	44
107426	90239	17186	13749	3437	0.03000	0.01042	0.10716	0.14759	45	45
107421	90370	17052	13641	3410	0.03000	0.01040	0.10876	0.14916	45	46
107417	90499	16918	13534	3384	0.03000	0.01037	0.11052	0.15089	44	47
107413	90630	16783	13427	3357	0.03000	0.01034	0.11247	0.15281	44	48



Interest rate change									
New rate 5.828 per cent per annum									
New mortgage repayment \$451.70									
49	0.944	0.996	26009.96	1412.96	840.35	122.11	101211	93000	10841 5304
50	0.943	0.996	26051.80	1414.87	842.27	122.30	101724	93000	10841 5308
51	0.942	1.007	26093.95	1416.81	844.20	122.48	102239	93000	10841 5312
52	0.941	0.994	26135.87	1418.73	846.12	122.66	102757	93000	10841 5317
53	0.952	1.005	26178.33	1420.67	848.07	122.85	103279	93000	10841 5321
54	0.940	0.992	26220.32	1422.60	850.00	123.03	103802	93000	10841 5325
55	0.939	1.004	26262.60	1424.54	851.93	123.22	104328	93000	10841 5329
56	0.950	1.003	26305.17	1426.49	853.88	123.40	104858	93000	10841 5333
57	0.938	1.002	26347.52	1428.43	855.83	123.58	105389	93000	10841 5337
58	0.948	1.001	26390.15	1430.38	857.78	123.77	105924	93000	10841 5342
59	0.936	1.000	26432.57	1432.33	859.72	123.95	106459	93000	10841 5346
60	0.947	1.000	26475.27	1434.28	861.68	124.14	107000	93000	10841 5350
61	3.741	1.994	26600.17	1440.01	867.40	124.58	107505	93000	10841 5366
62	3.741	2.003	26725.85	1445.77	873.17	125.03	108013	93000	10841 5383
63	3.730	2.000	26851.79	1451.54	878.94	125.47	108522	93000	10841 5399
64	3.741	1.997	26978.51	1457.35	884.75	125.91	109034	93000	10841 5416
65	3.741	2.006	27106.02	1463.19	890.59	126.36	109550	93000	10841 5432

109145	91090	18055	14444	3611	0.03000	0.02109	0.11464	0.16573	44
109149	91352	17598	14078	3520	0.03000	0.02082	0.11706	0.16789	43
109153	92015	17138	13710	3428	0.03000	0.02056	0.11977	0.17033	43
109157	92481	16676	13341	3335	0.03000	0.02030	0.12279	0.17309	42
109162	92951	16211	12969	3242	0.03000	0.02004	0.12614	0.17618	42
109166	93422	15744	12595	3149	0.03000	0.01979	0.12981	0.17960	41
109170	93895	15275	12220	3055	0.03000	0.01954	0.13379	0.18333	41
109174	94372	14802	11842	2960	0.03000	0.01929	0.13804	0.18733	41
109178	94850	14328	11463	2866	0.03000	0.01904	0.14251	0.19156	40
109183	95331	13851	11081	2770	0.03000	0.01880	0.14713	0.19592	40
109187	95813	13373	10699	2675	0.03000	0.01856	0.15177	0.20033	39
109191	96300	12891	10313	2578	0.03000	0.01833	0.15633	0.20466	39
109207	96755	12453	9962	2491	0.03000	0.01777	0.16069	0.20846	39
109224	97212	12012	9609	2402	0.03000	0.01723	0.16470	0.21193	38
109240	97669	11571	9257	2314	0.03000	0.01671	0.16823	0.21495	38
109257	98131	11126	8901	2225	0.03000	0.01621	0.17118	0.21739	37
109273	98595	10679	8543	2136	0.03000	0.01571	0.17344	0.21916	37

66	3.740	1.990	27233.78	1469.05	896.45	126.80	110065	93000	10841	5449
67	3.729	1.999	27362.09	1474.93	902.33	127.24	110585	93000	10841	5466
68	3.740	2.008	27491.44	1480.86	908.26	127.69	111107	93000	10841	5483
69	3.740	1.992	27621.05	1486.80	914.20	128.13	111631	93000	10841	5499
70	3.739	2.001	27751.46	1492.78	920.17	128.57	112159	93000	10841	5516
71	3.739	2.010	27882.69	1498.79	926.19	129.02	112688	93000	10841	5533
72	3.739	1.994	28014.17	1504.82	932.21	129.46	113220	93000	10841	5550
Interest rate change										
New rate 6.599 per cent per annum										
New mortgage repayment \$511.43										
73	2.703	0.500	28088.19	1508.21	875.88	121.37	114114	93000	12274	5562
74	2.697	0.500	28162.26	1511.60	879.28	121.57	115014	93000	12274	5575
75	2.713	0.500	28236.89	1515.02	882.70	121.77	115922	93000	12274	5587
76	2.696	0.500	28311.31	1518.44	886.11	121.97	116837	93000	12274	5600
77	2.701	0.500	28386.04	1521.86	889.53	122.17	117758	93000	12274	5613
78	2.706	0.499	28461.09	1525.30	892.97	122.37	118688	93000	12274	5625
79	2.700	0.499	28536.18	1528.74	896.41	122.57	119624	93000	12274	5637
80	2.705	0.499	28611.57	1532.20	899.87	122.77	120568	93000	12274	5650
81	2.699	0.499	28687.02	1535.66	903.33	122.96	121519	93000	12274	5662
82	2.703	0.499	28762.78	1539.13	906.80	123.16	122478	93000	12274	5675
83	2.708	0.510	28839.12	1542.63	910.30	123.36	123445	93000	12274	5687
84	2.702	0.498	28915.23	1546.11	913.79	123.56	124420	93000	12274	5700
85	2.631	2.500	29037.58	1551.72	919.39	124.05	126150	93000	12274	5712
86	2.636	2.495	29160.43	1557.35	925.03	124.54	127905	93000	12274	5725
87	2.630	2.502	29283.83	1563.01	930.68	125.03	129684	93000	12274	5737
88	2.625	2.497	29407.50	1568.68	936.35	125.52	131486	93000	12274	5750
89	2.640	2.503	29532.22	1574.39	942.07	126.01	133315	93000	12274	5762
90	2.624	2.490	29656.95	1580.11	947.78	126.50	135169	93000	12274	5775

109290	99060	10230	8184	2046	0.03000	0.01524	0.17497	0.22021	37	66
109307	99527	9780	7828	1956	0.03000	0.01478	0.17572	0.22050	36	67
109323	99996	9327	7462	1865	0.03000	0.01433	0.17570	0.22003	36	68
109340	100468	8872	7098	1774	0.03000	0.01390	0.17493	0.21883	35	69
109357	100943	8414	6731	1683	0.03000	0.01348	0.17349	0.21697	35	70
109374	101419	7954	6364	1591	0.03000	0.01307	0.17144	0.21450	35	71
109391	101898	7493	5994	1499	0.03000	0.01267	0.16886	0.21153	34	72
110937	102702	8134	6507	1627	0.03000	0.02321	0.16595	0.21805	34	73
110949	103512	7337	5869	1467	0.03000	0.02190	0.16249	0.21439	34	74
110861	104330	6531	5225	1306	0.03000	0.02160	0.15888	0.21048	33	75
110874	105153	5721	4577	1144	0.03000	0.02130	0.15509	0.20639	33	76
110886	105982	4904	3923	981	0.03000	0.02101	0.15120	0.20221	33	77
110899	106819	4079	3264	816	0.03000	0.02072	0.14726	0.19798	32	78
110911	107661	3250	2600	650	0.03000	0.02043	0.14333	0.19377	32	79
110924	108511	2413	1930	483	0.03000	0.02015	0.13945	0.18961	32	80
110936	109367	1569	1256	314	0.03000	0.01988	0.13566	0.18554	31	81
110949	110230	719	575	144	0.03000	0.01961	0.13198	0.18159	31	82
110962	111101	0	0	0	0.03000	0.01934	0.12844	0.17777	31	83
110974	111978	0	0	0	0.03000	0.01907	0.12504	0.17411	30	84
110987	112535	0	0	0	0.03000	0.01884	0.12180	0.17024	30	85
110999	113114	0	0	0	0.03000	0.01862	0.11874	0.16656	30	86
111011	113715	0	0	0	0.03000	0.01723	0.11584	0.16306	29	87
111024	114338	0	0	0	0.03000	0.01665	0.11311	0.15976	29	88
111036	114984	0	0	0	0.03000	0.01609	0.11056	0.15665	29	89
111049	115652	0	0	0	0.03000	0.01555	0.10818	0.15373	29	90

91	2.639	2.505	29782.75	1585.88	953.55	127.00	137050	93000	12274	5787
92	2.623	2.500	29908.55	1591.64	959.31	127.49	138955	93000	12274	5800
93	2.638	2.495	30035.14	1597.30	964.97	127.96	140888	93000	12274	5812
94	2.633	2.501	30162.28	1602.60	970.27	128.39	142847	93000	12274	5825
95	2.627	2.496	30289.70	1607.90	975.58	128.81	144834	93000	12274	5837
96	2.632	2.503	30417.93	1613.25	980.92	129.24	146848	93000	12274	5850
97	5.132	0.997	30570.32	1619.60	987.27	129.53	149720	93000	12274	5874
98	5.121	1.008	30723.48	1625.98	993.65	129.83	152645	93000	12274	5899
99	5.131	0.995	30877.34	1632.39	1000.06	130.12	155630	93000	12274	5924
100	5.131	1.006	31032.23	1638.84	1006.51	130.42	158672	93000	12274	5948
101	5.130	0.994	31187.55	1645.31	1012.99	130.71	161775	93000	12274	5973
102	5.119	1.004	31343.65	1651.82	1019.49	131.00	164936	93000	12274	5998
103	5.128	1.004	31500.76	1658.36	1026.04	131.30	168160	93000	12274	6023
104	5.138	0.991	31658.56	1664.94	1032.61	131.59	171449	93000	12274	6048
105	5.126	1.002	31817.14	1671.55	1039.23	131.88	174891	93000	12274	6074
106	5.125	1.001	31976.47	1678.19	1045.86	132.17	178217	93000	12274	6099
107	5.124	1.000	32136.54	1684.86	1052.53	132.46	181701	93000	12274	6124
108	5.133	0.999	32297.63	1691.57	1059.24	132.75	185254	93000	12274	6150

111061	123345	0	0	0	0.03000	0.01503	0.10597	0.15100	28	q1
111074	125059	0	0	0	0.03000	0.01453	0.10392	0.14844	28	q2
111086	126799	0	0	0	0.03000	0.01406	0.10203	0.14608	28	q3
111099	128563	0	0	0	0.03000	0.01365	0.10029	0.14394	28	q4
111112	130351	0	0	0	0.03000	0.01325	0.09871	0.14197	27	q5
111124	132163	0	0	0	0.03000	0.01287	0.09728	0.14015	27	q6
111149	134748	0	0	0	0.03000	0.01261	0.09598	0.13859	27	q7
111173	137380	0	0	0	0.03000	0.01235	0.09483	0.13718	26	q8
111198	140067	0	0	0	0.03000	0.01210	0.09380	0.13591	26	q9
111223	142805	0	0	0	0.03000	0.01186	0.09291	0.13477	26	q10
111247	145597	0	0	0	0.03000	0.01162	0.09214	0.13376	26	q11
111272	148462	0	0	0	0.03000	0.01139	0.09149	0.13288	25	q12
111297	151344	0	0	0	0.03000	0.01116	0.09096	0.13212	25	q13
111323	154304	0	0	0	0.03000	0.01094	0.09054	0.13148	25	q14
111348	157321	0	0	0	0.03000	0.01072	0.09023	0.13095	25	q15
111373	160396	0	0	0	0.03000	0.01050	0.09003	0.13054	25	q16
111399	163531	0	0	0	0.03000	0.01029	0.08994	0.13023	24	q17
111424	166729	0	0	0	0.03000	0.01009	0.08994	0.13003	24	q18

Interest rate change !										
New rate 8.996 per cent per annum										
New mortgage repayment £697.22										
109	5.695	0.000	32447.04	1697.79	879.67	109.74	185318	93000	16733	6178
110	5.688	0.000	32596.97	1704.04	885.92	110.01	185379	93000	16733	6207
111	5.692	0.000	32747.69	1710.32	892.20	110.28	185442	93000	16733	6236
112	5.685	0.000	32898.94	1716.62	898.50	110.55	185504	93000	16733	6265
113	5.699	0.000	33051.23	1722.97	904.85	110.81	185568	93000	16733	6294
114	5.692	0.000	33204.05	1729.34	911.21	111.08	185631	93000	16733	6323
115	5.685	0.000	33357.41	1735.73	917.60	111.35	185692	93000	16733	6352
116	5.688	0.000	33511.54	1742.15	924.03	111.61	185755	93000	16733	6381
117	5.701	0.000	33666.73	1748.61	930.49	111.87	185819	93000	16733	6411
118	5.684	0.000	33822.18	1755.09	936.97	112.13	185881	93000	16733	6440
119	5.696	0.000	33978.68	1761.61	943.49	112.39	185944	93000	16733	6470
120	5.689	0.000	34135.70	1768.15	950.03	112.65	186008	93000	16733	6500
121	7.689	-0.502	34332.69	1776.36	958.24	112.93	184642	93000	16733	6540
122	7.699	-0.502	34531.08	1784.63	966.51	113.20	183287	93000	16733	6581
123	7.689	-0.491	34730.66	1792.94	974.82	113.47	181942	93000	16733	6622

115912	166786	0	0	0	0.03000	0.04973	0.09004	0.16977	24	109
115940	166842	0	0	0	0.03000	0.04880	0.09023	0.16903	24	110
115969	166898	0	0	0	0.03000	0.04790	0.09052	0.16841	23	111
115998	166954	0	0	0	0.03000	0.04701	0.09089	0.16790	23	112
116027	167011	0	0	0	0.03000	0.04615	0.09134	0.16749	23	113
116056	167068	0	0	0	0.03000	0.04531	0.09188	0.16718	23	114
116085	167123	0	0	0	0.03000	0.04448	0.09249	0.16697	22	115
116114	167180	0	0	0	0.03000	0.04368	0.09317	0.16684	22	116
116144	167237	0	0	0	0.03000	0.04289	0.09391	0.16680	22	117
116174	167293	0	0	0	0.03000	0.04213	0.09472	0.16684	22	118
116203	167350	0	0	0	0.03000	0.04137	0.09558	0.16695	22	119
116233	167407	0	0	0	0.03000	0.04063	0.09650	0.16713	21	120
116274	167472	0	0	0	0.03000	0.03987	0.09747	0.16734	21	121
116314	167538	0	0	0	0.03000	0.03912	0.09849	0.16761	21	122
116355	167607	0	0	0	0.03000	0.03839	0.09955	0.16794	21	123



124	7.689	-0.502	34931.05	1801.29	983.17	113.74	180606	93000	16733	6663
125	7.698	-0.502	35132.84	1809.70	991.58	114.00	179280	93000	16733	6704
126	7.687	-0.503	35335.49	1818.15	1000.02	114.27	177964	93000	16733	6745
127	7.695	-0.503	35539.52	1826.65	1008.52	114.53	176657	93000	16733	6787
128	7.693	-0.492	35745.03	1835.21	1017.09	114.79	175360	93000	16733	6829
129	7.691	-0.503	35951.31	1843.80	1025.68	115.03	174073	93000	16733	6872
130	7.689	-0.503	36158.72	1852.45	1034.32	115.30	172795	93000	16733	6914
131	7.696	-0.492	36367.86	1861.16	1043.04	115.56	171527	93000	16733	6957
132	7.693	-0.504	36577.77	1869.91	1051.78	115.81	170268	93000	16733	7000
133	7.141	-0.504	36773.13	1878.05	1059.92	116.04	170014	93000	16733	7040
134	7.144	-0.493	36969.96	1886.25	1068.13	116.26	169760	93000	16733	7081
135	7.147	-0.504	37167.57	1894.48	1076.36	116.49	169507	93000	16733	7122
136	7.140	-0.505	37366.05	1902.75	1084.63	116.71	169253	93000	16733	7163
137	7.143	-0.493	37566.01	1911.08	1092.96	116.93	169000	93000	16733	7204
138	7.145	-0.505	37766.73	1919.45	1101.32	117.15	168748	93000	16733	7246
139	7.138	-0.494	37968.68	1927.86	1109.74	117.37	168496	93000	16733	7287
140	7.148	-0.506	38171.64	1936.32	1118.20	117.59	168244	93000	16733	7330
141	7.141	-0.494	38375.83	1944.83	1126.70	117.80	168000	93000	16733	7372
142	7.142	-0.506	38580.76	1953.37	1135.24	118.01	167748	93000	16733	7414
143	7.143	-0.495	38787.18	1961.97	1143.84	118.23	167500	93000	16733	7457
144	7.143	-0.506	38994.35	1970.60	1152.48	118.44	167253	93000	16733	7500
145	4.665	1.009	39175.54	1978.15	1160.02	118.76	167000	93000	16733	7529
146	4.672	0.996	39357.38	1985.72	1167.60	119.08	166748	93000	16733	7557
147	4.662	0.995	39539.72	1993.32	1175.20	119.40	166496	93000	16733	7586
148	4.669	1.006	39723.48	2000.98	1182.86	119.72	166244	93000	16733	7615
149	4.667	0.994	39907.63	2008.65	1190.53	120.04	166000	93000	16733	7644
150	4.665	1.004	40092.93	2016.37	1198.25	120.36	165748	93000	16733	7673
151	4.663	1.004	40279.02	2024.13	1206.00	120.68	165500	93000	16733	7702
152	4.670	0.991	40465.75	2031.91	1213.78	121.00	165253	93000	16733	7732
153	4.668	1.002	40653.65	2039.74	1221.61	121.32	165000	93000	16733	7761
154	4.666	1.001	40842.33	2047.60	1229.47	121.64	164748	93000	16733	7791
155	4.664	1.000	41031.79	2055.49	1237.37	121.95	164500	93000	16733	7820
156	4.670	0.999	41222.30	2063.43	1245.31	122.27	164253	93000	16733	7850

116396	162545	0	0	0	0.03000	0.03769	0.10066	0.16834	21	124
116437	161352	0	0	0	0.03000	0.03700	0.10182	0.16882	20	116
116479	160167	0	0	0	0.03000	0.03633	0.10304	0.16936	20	116
116520	158992	0	0	0	0.03000	0.03567	0.10432	0.17000	20	117
116563	157824	0	0	0	0.03000	0.03503	0.10569	0.17073	20	118
116605	156666	0	0	0	0.03000	0.03442	0.10716	0.17158	20	119
116647	155515	0	0	0	0.03000	0.03381	0.10876	0.17258	19	130
116690	154374	0	0	0	0.03000	0.03322	0.11052	0.17374	19	131
116733	153241	0	0	0	0.03000	0.03264	0.11247	0.17511	19	132
116774	152127	0	0	0	0.03000	0.03213	0.11464	0.17677	19	133
116814	151012	0	0	0	0.03000	0.03163	0.11706	0.17869	19	134
116855	150899	0	0	0	0.03000	0.03114	0.11977	0.18092	18	135
116896	150784	0	0	0	0.03000	0.03067	0.12279	0.18346	18	136
116937	150670	0	0	0	0.03000	0.03020	0.12614	0.18634	18	137
116979	150557	0	0	0	0.03000	0.02974	0.12981	0.18955	18	138
117021	150441	0	0	0	0.03000	0.02930	0.13379	0.19308	18	139
117063	150327	0	0	0	0.03000	0.02886	0.13804	0.19690	17	140
117105	150214	0	0	0	0.03000	0.02843	0.14251	0.20095	17	141
117148	150100	0	0	0	0.03000	0.02802	0.14712	0.20514	17	142
117190	150087	0	0	0	0.03000	0.02761	0.15177	0.20938	17	143
117233	150074	0	0	0	0.03000	0.02721	0.15633	0.21354	17	144
117262	150052	0	0	0	0.03000	0.02681	0.16069	0.21729	17	145
117291	150033	0	0	0	0.03000	0.02642	0.16470	0.22072	16	146
117319	150015	0	0	0	0.03000	0.02603	0.16823	0.22368	16	147
117348	150000	0	0	0	0.03000	0.02565	0.17118	0.22606	16	148
117377	150088	0	0	0	0.03000	0.02524	0.17344	0.22778	16	149
117406	150077	0	0	0	0.03000	0.02481	0.17497	0.22877	16	150
117436	150068	0	0	0	0.03000	0.02438	0.17572	0.22900	16	151
117465	150053	0	0	0	0.03000	0.02398	0.17570	0.22847	15	152
117494	150039	0	0	0	0.03000	0.02358	0.17493	0.22722	15	153
117524	150025	0	0	0	0.03000	0.02318	0.17349	0.22529	15	154
117554	150010	0	0	0	0.03000	0.02278	0.17144	0.22276	15	155
117583	150001	0	0	0	0.03000	0.02238	0.16886	0.21972	15	156

Interest rate change 1									
New rate 7.682 per cent per annum									
New mortgage repayment £55.33									
157	3.818	4.002	41486.66	2074.44	1358.21	132.94	177467	93000	14288 7875
158	3.822	4.001	41752.79	2085.53	1369.30	133.61	178318	93000	14288 7899
159	3.825	3.999	42020.69	2096.70	1380.47	134.28	179172	93000	14288 7924
160	3.821	3.997	42290.11	2107.92	1391.69	134.95	180030	93000	14288 7949
161	3.825	4.008	42561.73	2119.24	1403.01	135.62	180892	93000	14288 7974
162	3.820	3.994	42834.48	2130.60	1414.37	136.29	181757	93000	14288 7999
163	3.824	4.004	43109.44	2142.06	1425.83	136.96	182628	93000	14288 8024
164	3.819	4.003	43385.96	2153.58	1437.35	137.64	183502	93000	14288 8049
165	3.822	4.001	43664.30	2165.18	1448.95	138.32	184380	93000	14288 8074
166	3.818	3.999	43944.21	2176.84	1460.61	139.00	185263	93000	14288 8099
167	3.821	3.997	44225.96	2188.58	1472.35	139.68	186148	93000	14288 8125
168	3.824	3.995	44509.57	2200.40	1484.17	140.36	187041	93000	14288 8150
169	4.293	1.504	44721.38	2209.22	1492.99	140.70	187947	93000	14288 8179
170	4.293	1.503	44934.12	2218.09	1501.86	141.04	192089	93000	14288 8207
171	4.301	1.501	45148.08	2227.00	1510.77	141.38	194666	93000	14288 8236
172	4.293	1.499	45362.70	2235.95	1519.72	141.72	197375	93000	14288 8265
173	4.293	1.497	45578.27	2244.93	1528.70	142.06	199822	93000	14288 8294
174	4.292	1.495	45794.78	2253.95	1537.72	142.40	202601	93000	14288 8323
175	4.300	1.504	46012.93	2263.04	1546.81	142.74	205319	93000	14288 8352
176	4.292	1.502	46231.76	2272.16	1555.93	143.08	208071	93000	14288 8382
177	4.291	1.501	46451.54	2281.31	1565.09	143.42	210860	93000	14288 8411
178	4.298	1.499	46672.56	2290.52	1574.29	143.75	213889	93000	14288 8441
179	4.290	1.497	46894.25	2299.76	1583.53	144.09	216952	93000	14288 8470
180	4.297	1.506	47117.61	2309.07	1592.84	144.43	219456	93000	14288 8500
Interest rate change 1									
New rate 7.790 per cent per annum									
New mortgage repayment £63.72									
181	2.940	0.000	47231.52	2313.81	1589.19	143.75	219711	93000	14489 8521

115162	159720	0	0	0	0	0.03000	0.00996	0.16585	0.20580	15	147
115167	160486	0	0	0	0	0.03000	0.00951	0.16249	0.20200	14	158
115212	161254	0	0	0	0	0.03000	0.00908	0.15888	0.19796	14	159
115237	162027	0	0	0	0	0.03000	0.00866	0.15509	0.19376	14	160
115262	162803	0	0	0	0	0.03000	0.00827	0.15120	0.18947	14	161
115287	163581	0	0	0	0	0.03000	0.00789	0.14726	0.18516	14	162
115312	164365	0	0	0	0	0.03000	0.00753	0.14333	0.18087	14	163
115337	165152	0	0	0	0	0.03000	0.00719	0.13945	0.17664	14	164
115362	165942	0	0	0	0	0.03000	0.00686	0.13566	0.17252	13	165
115387	166736	0	0	0	0	0.03000	0.00654	0.13198	0.16852	13	166
115412	167533	0	0	0	0	0.03000	0.00624	0.12844	0.16468	13	167
115438	168337	0	0	0	0	0.03000	0.00595	0.12504	0.16099	13	168
115467	170593	0	0	0	0	0.03000	0.00581	0.12180	0.15762	13	169
115495	172880	0	0	0	0	0.03000	0.00568	0.11874	0.15441	13	170
115524	175200	0	0	0	0	0.03000	0.00555	0.11584	0.15138	13	171
115553	177548	0	0	0	0	0.03000	0.00542	0.11311	0.14853	13	172
115582	179929	0	0	0	0	0.03000	0.00529	0.11056	0.14585	12	173
115611	182340	0	0	0	0	0.03000	0.00517	0.10818	0.14335	12	174
115640	184787	0	0	0	0	0.03000	0.00505	0.10597	0.14101	12	175
115670	187264	0	0	0	0	0.03000	0.00493	0.10392	0.13885	12	176
115699	189774	0	0	0	0	0.03000	0.00482	0.10203	0.13684	12	177
115729	192320	0	0	0	0	0.03000	0.00470	0.10029	0.13500	12	178
115758	194897	0	0	0	0	0.03000	0.00460	0.09871	0.13331	12	179
115788	197511	0	0	0	0	0.03000	0.00449	0.09728	0.13177	12	180
116010	197740	0	0	0	0	0.03000	0.00471	0.09598	0.13069	12	181

182	2.940	0.000	47345.71	2318.57	1593.95	143.84	219964	93000	14489	8541
183	2.940	0.000	47460.18	2323.34	1598.72	143.92	220218	93000	14489	8562
184	2.947	0.000	47575.20	2328.13	1603.51	144.00	220474	93000	14489	8583
185	2.940	0.000	47690.22	2332.93	1608.30	144.08	220730	93000	14489	8603
186	2.940	0.000	47805.52	2337.73	1613.11	144.17	220984	93000	14489	8624
187	2.940	0.000	47921.10	2342.55	1617.92	144.25	221240	93000	14489	8645
188	2.940	0.000	48036.95	2347.37	1622.75	144.33	221496	93000	14489	8666
189	2.940	0.000	48153.09	2352.21	1627.59	144.41	221752	93000	14489	8687
190	2.947	0.000	48269.77	2357.07	1632.45	144.49	222010	93000	14489	8708
191	2.940	0.000	48386.45	2361.94	1637.31	144.57	222266	93000	14489	8729
192	2.940	0.000	48503.41	2366.81	1642.19	144.65	222523	93000	14489	8750
Interest rate change 1										
New rate 5.067 per cent per annum										
New mortgage repayment £392.70										
193	1.144	0.000	48549.42	2368.73	1655.13	163.26	221783	93000	9425	8759
194	1.143	0.000	48595.43	2370.64	1657.04	163.27	221046	93000	9425	8767
195	1.142	0.000	48641.44	2372.56	1658.96	163.28	220313	93000	9425	8775
196	1.141	0.000	48687.45	2374.48	1660.88	163.30	219580	93000	9425	8783
197	1.147	0.000	48733.74	2376.41	1662.81	163.31	218852	93000	9425	8792
198	1.139	0.000	48779.75	2378.32	1664.72	163.32	218124	93000	9425	8800
199	1.145	0.000	48826.04	2380.25	1666.65	163.34	217401	93000	9425	8808
200	1.143	0.000	48872.32	2382.18	1668.58	163.35	216677	93000	9425	8817
201	1.142	0.000	48918.61	2384.11	1670.51	163.37	215958	93000	9425	8825
202	1.141	0.000	48964.90	2386.04	1672.44	163.38	215240	93000	9425	8833
203	1.140	0.000	49011.19	2387.97	1674.37	163.39	214524	93000	9425	8842
204	1.146	0.000	49057.75	2389.91	1676.31	163.41	213813	93000	9425	8850

116031	197967	0	0	0	0.03000	0.00458	0.09483	0.12951	11	192
116051	198196	0	0	0	0.03000	0.00465	0.09380	0.12846	11	193
116072	198426	0	0	0	0.03000	0.00462	0.09291	0.12753	11	194
116093	198657	0	0	0	0.03000	0.00460	0.09214	0.12674	11	195
116113	198886	0	0	0	0.03000	0.00457	0.09149	0.12606	11	196
116134	199116	0	0	0	0.03000	0.00455	0.09096	0.12551	11	197
116155	199346	0	0	0	0.03000	0.00452	0.09054	0.12506	11	198
116176	199576	0	0	0	0.03000	0.00447	0.09023	0.12473	11	199
116197	199809	0	0	0	0.03000	0.00445	0.09003	0.12450	11	200
116218	200039	0	0	0	0.03000	0.00443	0.08994	0.12438	10	191
116239	200271	0	0	0	0.03000	0.00442	0.08994	0.12436	10	192
111183	199605	0	0	0	0.03000	0.00132	0.09004	0.12136	10	193
111191	199942	0	0	0	0.03000	0.00132	0.09023	0.12145	10	194
111200	198282	0	0	0	0.03000	0.00132	0.09052	0.12173	10	195
111208	197622	0	0	0	0.03000	0.00131	0.09089	0.12210	10	196
111216	196967	0	0	0	0.03000	0.00131	0.09134	0.12256	10	197
111225	196311	0	0	0	0.03000	0.00131	0.09188	0.12309	10	198
111233	195661	0	0	0	0.03000	0.00131	0.09249	0.12370	10	199
111241	195010	0	0	0	0.03000	0.00131	0.09317	0.12437	10	200
111250	194362	0	0	0	0.03000	0.00131	0.09391	0.12512	10	201
111258	193716	0	0	0	0.03000	0.00131	0.09472	0.12593	9	202
111266	193071	0	0	0	0.03000	0.00131	0.09558	0.12679	9	203
111275	192431	0	0	0	0.03000	0.00130	0.09650	0.12771	9	204

Interest rate change !  
 New rate 10.184 per cent per annum  
 New mortgage repayment £789.27

205	6.951	0.499	49353.73	2402.24	1492.06	129.22	215889	93000	18943	8900
206	6.954	0.499	49651.59	2414.65	1504.48	129.57	217986	93000	18943	8950
207	6.950	0.499	49951.07	2427.13	1516.95	129.91	220103	93000	18943	9000
208	6.952	0.498	50252.45	2439.69	1529.51	130.25	222242	93000	18943	9051
209	6.954	0.498	50555.72	2452.32	1542.15	130.60	224401	93000	18943	9101
210	6.949	0.498	50860.61	2465.03	1554.85	130.94	226580	93000	18943	9152
211	6.951	0.509	51167.87	2477.83	1567.65	131.28	228780	93000	18943	9204
212	6.953	0.498	51476.58	2490.69	1580.52	131.62	231004	93000	18943	9256
213	6.954	0.497	51787.19	2503.63	1593.46	131.95	233247	93000	18943	9308
214	6.948	0.497	52099.44	2516.64	1606.47	132.29	235513	93000	18943	9360
215	6.956	0.508	52414.35	2529.76	1619.59	132.62	237801	93000	18943	9412
216	6.950	0.497	52730.42	2542.93	1632.76	132.95	240111	93000	18943	9465

120842	194300	0	0	0	0	0.03000	0.01289	0.09747	0.14036	9	205
120892	196188	0	0	0	0	0.03000	0.01258	0.09849	0.14107	9	206
120943	198093	0	0	0	0	0.03000	0.01228	0.09955	0.14183	9	207
120993	200018	0	0	0	0	0.03000	0.01199	0.10066	0.14265	9	208
121044	201961	0	0	0	0	0.03000	0.01171	0.10182	0.14353	9	209
121095	203922	0	0	0	0	0.03000	0.01144	0.10304	0.14447	9	210
121146	205902	0	0	0	0	0.03000	0.01117	0.10432	0.14549	9	211
121198	207903	0	0	0	0	0.03000	0.01091	0.10569	0.14660	9	212
121250	209923	0	0	0	0	0.03000	0.01066	0.10716	0.14783	8	213
121302	211963	0	0	0	0	0.03000	0.01042	0.10876	0.14918	8	214
121355	214021	0	0	0	0	0.03000	0.01018	0.11052	0.15070	8	215
121408	216100	0	0	0	0	0.03000	0.00995	0.11247	0.15242	8	216



Interest rate change 1									
New rate 9.724 per cent per annum									
New mortgage repayment £753.59									
217	7.498	1.496	53114.79	2558.95	1684.46	136.34	242059	93000	18086
218	7.498	1.505	53502.37	2575.10	1700.60	136.82	244024	93000	18086
219	7.505	1.493	53892.51	2591.35	1716.86	137.30	246005	93000	18086
220	7.499	1.502	54285.61	2607.73	1733.24	137.77	248002	93000	18086
221	7.498	1.500	54681.48	2624.23	1749.73	138.25	250016	93000	18086
222	7.498	1.509	55080.63	2640.86	1766.37	138.73	252040	93000	18086
223	7.503	1.496	55482.35	2657.60	1783.10	139.20	254090	93000	18086
224	7.502	1.494	55886.87	2674.45	1799.96	139.67	256153	93000	18086
225	7.494	1.503	56294.41	2691.43	1816.94	140.14	258232	93000	18086
226	7.499	1.501	56705.04	2708.54	1834.05	140.61	260328	93000	18086
227	7.504	1.499	57118.78	2725.78	1851.29	141.08	262442	93000	18086
228	7.501	1.498	57535.36	2743.14	1868.65	141.55	264572	93000	18086
229	8.372	2.002	58017.90	2763.25	1888.75	142.11	266351	93000	18086
230	8.370	1.999	58504.27	2783.51	1909.02	142.68	268141	93000	18086
231	8.369	2.006	58995.01	2803.96	1929.47	143.25	269943	93000	18086
232	8.373	1.992	59489.38	2824.56	1950.06	143.81	271758	93000	18086
233	8.377	2.000	59988.42	2845.35	1970.86	144.37	273586	93000	18086
234	8.368	2.007	60491.60	2866.32	1991.82	144.93	275424	93000	18086
235	8.371	1.993	60998.45	2887.44	2012.94	145.49	277276	93000	18086
236	8.374	2.001	61510.04	2908.75	2034.26	146.05	279140	93000	18086
237	8.370	1.997	62025.56	2930.23	2055.74	146.61	281016	93000	18086
238	8.378	2.005	62546.15	2951.92	2077.43	147.16	282906	93000	18086
239	8.367	2.001	63070.43	2973.77	2099.27	147.72	284807	93000	18086
240	8.374	1.998	63599.28	2995.80	2121.31	148.27	286722	93000	18086

Of ten thousand mortgages, 2560 defaulted, 6660 repaid early, and 779 were repaid at maturity.  
 Total loss to insurer is £ 33946300, or £394.63 per mortgage, £ 1328.55 per claim.  
 Total loss to lender is £ 26932700, or £2693.27 per mortgage, £ 10519.22 per claim.  
 Total discounted loss to insurer is £ 28861772, or £2886.18 per mortgage, £ 11272.67 per claim.  
 Total discounted loss to lender is £ 23048384, or £2304.84 per mortgage, £ 9002.11 per claim.  
 Appropriate pure premium rate is discounted claim per policy divided by excess mortgage over 75%.

120609	217853	0	0	0	0.03000	0.00787	0.11464	0.15250	8	217
120666	219621	0	0	0	0.03000	0.00761	0.11706	0.15467	8	218
120734	221404	0	0	0	0.03000	0.00736	0.11977	0.15713	8	219
120782	223202	0	0	0	0.03000	0.00712	0.12279	0.15992	8	220
120841	225014	0	0	0	0.03000	0.00689	0.12614	0.16303	8	221
120900	226840	0	0	0	0.03000	0.00667	0.12981	0.16648	8	222
120959	228681	0	0	0	0.03000	0.00645	0.13379	0.17024	8	223
121019	230538	0	0	0	0.03000	0.00624	0.13804	0.17429	8	224
121079	232409	0	0	0	0.03000	0.00604	0.14251	0.17856	8	225
121139	234295	0	0	0	0.03000	0.00585	0.14712	0.18297	7	226
121200	236198	0	0	0	0.03000	0.00566	0.15177	0.18743	7	227
121261	238115	0	0	0	0.03000	0.00548	0.15633	0.19182	7	228
121330	239716	0	0	0	0.03000	0.00537	0.16069	0.19596	7	229
121399	241327	0	0	0	0.03000	0.00507	0.16470	0.19977	7	230
121468	242949	0	0	0	0.03000	0.00487	0.16823	0.20311	7	231
121538	244582	0	0	0	0.03000	0.00469	0.17118	0.20587	7	232
121608	246227	0	0	0	0.03000	0.00451	0.17344	0.20795	7	233
121679	247882	0	0	0	0.03000	0.00434	0.17497	0.20930	7	234
121750	249548	0	0	0	0.03000	0.00417	0.17572	0.20989	7	235
121822	251226	0	0	0	0.03000	0.00401	0.17570	0.20971	7	236
121894	252914	0	0	0	0.03000	0.00386	0.17493	0.20880	7	237
121967	254616	0	0	0	0.03000	0.00371	0.17349	0.20721	7	238
122040	256326	0	0	0	0.03000	0.00357	0.17144	0.20501	7	239
122113	258050	0	0	0	0.03000	0.00344	0.16886	0.20230	6	240

```

#include <stdio.h>
float retriex(float pstate,float rates[10],float maxes[10],int divs);
float repay(float loan,float tax,float inist,float taxmax);
float max(float a,float b);
double pow(double a,double b);
double fabs(double a);
int rand(void);
void getrates(int *divs,float *rates,float *maxes,char numtax[3],float *tax,float *laxmax,int month);
void getyear(int *index,char field[6]);
main()
{
float netpay,houpr,loanam,salary,lipol,lrmax,delpol,savmort=10000,delmort=0,repmort=0;
char ntax[3]="001",lnd[16]="prich";
int n1,divs,sunrem=rand()/32767*64;
int *divp=&divs;
float p[16],cost[24],wages[24],houses[24],rates[10],maxes[10],inist[24],unemp[24];
float laxr,taxmax,lrcommit,uncomm,repaym,repay,lipay,lipr,lral,payprop;
double thosal=0,lkosal=0,dikosai=0,dikosf=0,discpv=1;
float *taxreb=&tax,*taxupp=&laxmax,*lpoint=&p[16];
float *ralep=&rates[1],*maxp=&maxes[1],*houp=&houpr,*toup=&loanam,*selp=&salary;
FILE *pofparin;
if((pofparin=fopen("c:\pcedos\pofparm","r"))!=NULL)
{
fscanf(pofparin,"%f%f",&*houp);
fscanf(pofparin,"%f%f",&*ralep);
fscanf(pofparin,"%f%f",&*selp);
}
printf("MONTHLY GAGE INDEMNITY INSURANCE SIMULATION\n");
getrates(divp,ralep,naxp,ntax,taxreb,taxupp,0);
getparin(lpoint,lind1);
strcpy(lind1,"wage");
lpoint=&wages[0];
getparin(lpoint,lind1);
strcpy(lind1,"teamp");
lpoint=&houses[0];
getparin(lpoint,lind1);
lpoint=&inist[0];
strcpy(lind1,"realr");
getparin(lpoint,lind1);
lpoint=&unemp[0];
strcpy(lind1,"unemp");

```



```

debtates(dhpr,ratep,maxp,ntax,taxreb,taxupp,0);
resout[2]=pow(pricte,12)-(1)*100;
resout[3]=pow(wagris,12)-(1)*100;
discpv=discpv/(1+ntax[n1]);
if(abs(pricte[n1]-ntax[n1-1])>0.000001)
{ntax=ntax[n1]+pricte[n1]/prices[n1-1]-1;
printf("Interest rate change from rate %5.9f per cent per annum to %5.9f per cent per annum\n",ntax*100);
repaym=repayfoanem,tax,ntax,taxreb,taxupp;
printf("New mortgage repayment €%d.2m",repaym);}
salary=salary*wagris*pricte;
resout[4]=salary;
pmpay=ntaxinc(salary,rate,makes,div);
resout[5]=pmpay;
uncomm=thpay-repaym-llpot;
resout[6]=uncomm;
resout[7]=uncomm*prices[0]/prices[n1]/uncomm*100;
houptd=houptd*houses[n1]/houses[n1-1]*prices[n1]/prices[n1-1];
resout[8]=houptd;
resout[9]=loanam;
resout[10]=loanam*lwat*24;
resout[11]=5000*prices[n1]/prices[0];
lose=loanam*(1+lwat*24)+5000*prices[n1]/prices[0];
resout[12]=lose;
resout[13]=0.9*houptd;
lose=max(lose-0.9*houptd,0);
resout[14]=lose;
lnloss=-max(-0.8*lose,-lnsmax);
resout[15]=lnloss;
resout[16]=lose-lnloss;
payprop=pow(2,10*(-uncomm*prices[0]/prices[n1]/uncomm));
resout[17]=divpr*50;
resout[18]=payprop*100;
resout[19]=unemp(n1+stunem)/pow(10,6)/2;
delpr=dhpr/2+payprop+unemp(n1+stunem)/pow(10,6)/2;
resout[20]=delpr*100;
resout[21]=survmort*0.00822;
resout[22]=survmort*delpr;
resout[23]=survmort*(1-0.00822-delpr);

```

[illegible]

```

if(months>0)printf("New tax structure starts at month %u\n",months);
if(taxes=fopen("term.txt"))!=NULL
{
    fscanf(taxes,"%u\n",&divs);
    printf("Tax structure is\n(There are %u different rates\n",divs);
    for(nc=1;nc<=divs;nc+=1)
    {
        fscanf(taxes,"%f\n",&tax);
        fscanf(taxes,"%f\n",&taxmax);
        printf("Mortgage interest relief is given at %5.1f per cent up to £%6.0f mortgage.\n",tax*100,"taxmax");
        for(nc=1;nc<=divs;nc+=1)
        {
            fscanf(taxes,"%f\n",&taxes);
            printf("Tax band %u finishes at £%6.0f and is taxed at %5.2f per cent\n",nc,"taxes","rates*100");
            rates++;
            taxes++;
        }
        printf("\n");
    }
    fclose(taxes);
}

float netinc(float grsinc, float rates[10], float maxes[10], int divs)
{
    int nc;
    float inc1=0.0;
    nc=1;
    maxes[0] = 0.0;
    while(grsinc > maxes[nc])
    {
        inc1=inc1+(maxes[nc]-maxes[nc-1])*(1-rates[nc]);
        nc = nc + 1;
    }
    inc1 = inc1 + 4*(grsinc - maxes[nc-1])*(1-rates[nc]);
    inc1 = inc1 / 12.0;
    return inc1;
}

float repay(float loan, float tax, float intst, float taxmax)
{
    if (loan>taxmax) loan=loan-taxmax*tax;
    return intst*loan;
}

float max(float a, float b)
{
    if (a>b) b=a;
    return b;
}

```