Subject SP8

CMP Upgrade 2021/22

CMP Upgrade

This CMP Upgrade lists the changes to the Syllabus objectives, Core Reading and the ActEd material since last year that might realistically affect your chance of success in the exam. It is produced so that you can manually amend your 2021 CMP to make it suitable for study for the 2022 exams. It includes replacement pages and additional pages where appropriate.

Alternatively, you can buy a full set of up-to-date Course Notes / CMP at a significantly reduced price if you have previously bought the full-price Course Notes / CMP in this subject. Please see our 2022 *Student Brochure* for more details.

We only accept the current version of assignments for marking, *ie* those published for the sessions leading to the 2022 exams. If you wish to submit your script for marking but have only an old version, then you can order the current assignments free of charge if you have purchased the same assignments in the same subject in a previous year, and have purchased marking for the 2022 session.

This CMP Upgrade contains:

- all significant changes to the Syllabus objectives and Core Reading
- additional changes to the ActEd Course Notes and Assignments that will make them suitable for study for the 2022 exams.

0 Changes to the Syllabus

This section contains all the ***non-trivial*** changes to the syllabus objectives.

Objectives 3.8.2 and 3.8.3 have changed order, and are now as follows:

3.8.2 Outline the different types of multivariate models.

3.8.3 Evaluate the uses of multivariate models in pricing.

1 Changes to the Core Reading and ActEd text

This section contains all the ***non-trivial*** changes to the Core Reading and ActEd text.

Chapter 2

Section 4.3

The last Core Reading bullet point in the first paragraph on page 23 has been deleted.

Section 5

In the second sentence of the second paragraph on page 29, the words 'have the option' have been replaced with 'are required'.

Chapter 3

Section 1

'Employment practices liability (EPL)' has been added to the bullet point list of the main types of liability insurance.

Section 1.1

Under 'Employers' liability' the following sentence of Core Reading has been deleted:

> **Loss of or damage to employees' property is usually also covered.**

The next paragraph of ActEd text has been deleted and the following paragraph of Core Reading now reads as follows:

> **The benefit can be in the form of regular payments to compensate for disabilities that reduce the employee's ability to work and/or lump sum payments to compensate for permanent injuries to the employee.**

A new sub-section of Core Reading on 'Employment practices liability' has been added after the sub-section on 'Directors' and Officers' (D&O) liability' as follows:

Employment practices liability (EPL)

This insurance product is a form of D&O insurance, specifically covering risks relating to employment practices. It indemnifies the company and directors against the liabilities for the legal costs and subsequent awards for defending employment-related claims.

It is more commonly now sold as a standalone product, although for reserving purposes it may continue to be considered alongside D&O insurance, depending on the materiality of the portfolio. The inflationary trends for EPL tend to be different to D&O.

Section 1.2

A new sub-section on 'Employment practices liability' has been added after the sub-section on 'Directors' and Officers' (D&O) liability' as follows:

Employment practices liability

The perils include defending against, and possible settlement costs of, the following:

- **unfair dismissal of an employee**
- **constructive dismissal of an employee**
- **discrimination against an employee, for example resulting in being overlooked for a promotion or paid less for doing an equivalent job**
- **failure to correctly follow misconduct procedures when dismissing an employee**
- failure to comply with working hours legislation
- wrongful demotion.

Section 1.3

A new sub-section on 'Employment practices liability' has been added after the sub-section on 'Directors' and Officers' liability' as follows:

Employment practices liability

EPL is usually written on a claims-made basis.

Section 1.4

On page 14, the sub-section heading 'Professional indemnity / Directors' and Officers' liability / Cyber' now also includes EPL.

Section 1.6

On page 19 the sub-section heading 'Directors' and Officers' liability' now also includes 'Employment practices liability'.

The following paragraph of Core Reading has also been added to the end of that sub-section:

For EPL policies, it is important also to consider the current legal environment and the industry being covered as this will have a material impact on the claim costs.

Section 3.4

The first sentence of the paragraph of Core Reading on page 44 under the heading 'Creditor insurance' now reads as follows:

The exposure measure for payment protection insurance on personal loans is normally the amount of the loan or the total amount payable under the policy.

Section 4.4

The last paragraph of ActEd text has been deleted.

Summary

The summary at the end of the chapter has been updated in light of the above changes.

Chapter 6

Section 2.3

The first sentence of Core Reading now reads as follows:

> **The smaller risks may not be ceded to the reinsurer because they are below the minimum retention.**

Section 3.7

In the second paragraph of Core Reading on page 26, the second sentence now reads as follows:

> **This is in excess of a specified retention, resulting from a catastrophic event.**

Section 7

The material in this section has been reordered to make it clearer that structured finance is a broader term than securitisation. Please replace pages 39 to 46 with the replacement pages provided at the end of this Upgrade to update your materials accordingly.

Summary

The summary at the end of the chapter has been updated in light of the above changes.

Chapter 7

Section 1.6

The first paragraph of ActEd text has been deleted.

Chapter 8

Section 3

A lot of additional material has been added to this section concerning 'climate change'. Please use replacement pages 29 to 40a provided at the end of this Upgrade to update your materials accordingly.

Summary

The summary at the end of the chapter has been updated in light of the above changes.

Chapter 9

Section 1.1

The sub-section on 'Climate change' has been updated. Please use replacement pages 9 to 14a provided at the end of this Upgrade to update your materials accordingly.

Section 3

Some of the material in this section has been re-written. Please cross out what is currently on page 18 and use replacement pages 19 to 22a provided at the end of this Upgrade to update your materials accordingly.

Chapter 10

Section 5

Sub-section 5.1 has been deleted, except for the final three paragraphs of ActEd text. The heading '5.1 Claim estimation methods' has been deleted and subsequent sub-sections have been renumbered accordingly.

Section 9

A new sub-section 9.6 has been added to the end of Section 9, as follows:

The effect of climate change

Climate change will increase uncertainty about trends in the data and the degree of confidence that can be placed in those projections. For example, using 30 years of past event data to calibrate a model may mean that it reflects a climate approximately 15 years out of date. Transition and liability risks may also include step-changes in the regulatory and legal environments.

Risks to the insurance industry from climate change can be broadly categorised as physical risks, transition risks or liability risks. These were discussed in Chapter 8.

Chapter 12

Section 1.1

The heading 'Office premium' (above the second bullet point list) has been changed to 'Additional loadings'.

The sub-section with the heading 'Other considerations', at the foot of page 5, has been deleted.

Section 4.1

The first paragraph of ActEd text under the heading 'Unusually heavy / light experience' has been replaced with:

> This is also the case for classes where risk is affected by the economy. An economic downturn in a particular year is likely to lead to an increase in, for example:
>
> - the frequency of theft claims in motor insurance
> - the frequency of claims due to unemployment under payment protection insurance.

Chapter 14

Section 1.5

Under the heading 'The fitting process' at the top of page 19, the sub-section with heading 'Choice of distribution' has been shortened. All but the first four paragraphs of this sub-section have been deleted, so that it now reads:

> ***Choice of distribution***
>
> We need to select a method of fitting to find parameter values for our chosen distribution.
>
> **Proprietary software packages are available, which help to fit a wide variety of distributions to the observed loss data. However, fitting routines can be developed in-house.**
>
> **Whichever approach is used, it is important to be aware of the underlying fitting algorithm (to choose the parameters of the distribution). Common methods are:**
>
> - **maximum likelihood estimation**
> - **method of least squares**
> - **method of moments.**
>
> We may use different methods (*eg* method of moments or method of maximum likelihood) and then select the one that gives the best fit to our data.

Chapter 15

Section 7

The second paragraph of this section has been replaced with the following two paragraphs of Core Reading and an additional paragraph of ActEd text:

> **This chapter has given an introduction to the methodology, focusing on the process of fitting curves and their applications within pricing. Like most actuarial methods the construction in practice is difficult, mainly, in this case, because of uncertainties in estimating and/or selecting appropriate curves. It is important to note that the modelled loss cost to layers (particularly high ones) can be extremely sensitive to the selected curve. Once the particular curve is selected, the application of the methodology is relatively consistent regardless of which specific curve has been chosen. This means that it is possible for the actuary to conduct an impact analysis testing out different benchmark curves, as well as blending curves to fit a specific need.**
>
> **Practitioners in many markets will not have access to sufficient relevant data to model curves with any confidence so judgement will be key, and it is important to monitor closely the emerging results. It will be difficult to improve on this situation in many markets without improved market-wide data collection. Aside from data gathering, there are limited benchmarks available. As mentioned throughout the chapter, judgment will be required to ensure the selected curve is appropriate for the task in hand.**
>
> The paragraph above highlights two key difficulties when using original loss curves in practice: a lack of relevant data and a lack of appropriate benchmarks. These difficulties mean that considerable judgement must be used in selecting the 'right' curve.

Chapter 16

Section 3.2

The final paragraph on page 26 has been amended and now reads as follows:

> **In the diagram below, it is the steepness of the log-likelihood curve that determines how well the parameters fit. Although not easy to see in 3D, Parameter 2 has a steep curvature indicating that the parameter is tightly defined, and Parameter 1 a shallow one. Hence Parameter 1 is poorly defined.**

Section 3.3

Some changes have been made to this section. Please cross out what is currently on page 33 and use replacement pages 29 to 32 provided at the end of this Upgrade to update your materials accordingly.

Section 5.4

Sub-section 5.4 has been deleted. Subsequent sub-sections have been renumbered accordingly.

Section 5.6

The final five paragraphs in this sub-section have been deleted. In other words, all the text starting from 'A subtle use of offsetting …' onwards has been deleted.

Chapter 17

Section 0

The second paragraph of Section 0 has been changed to read as follows:

> Section 1 concerns external data used for rating. It explains in broad terms:
>
> - the categories of external data available to insurers, which may provide further information on individual risks
> - how such external rating factors affect claims experience for UK motor and household insurance.

Section 1

The heading for Section 1 has been changed from 'Risk and rating factors' to 'External data for rating'. The sentence beneath the heading has been deleted.

Sub-sections 1.1 and 1.2 have been deleted.

The sub-heading '1.3 External data' has been deleted.

The first two paragraphs of Section 1.3 have been replaced with the following four paragraphs:

> Rather than restricting themselves to the data available within the policy and claim records, insurers are increasingly testing and using rating factors that originate from external data. This section discusses the use of such data, with a focus on motor and household business.
>
> **In addition to the factors requested at the point of sale, many other factors from other data sources, *eg* external data, can be used to predict claims experience.**
>
> The 'factors requested at the point of sale' refers to rating factor information collected from policyholders on the proposal form, *ie* internal data. The rating factors typically used for different classes, including motor and household, were covered in Chapter 3.
>
> **To attach external data to assist in a modelling exercise the source data needs to include linking fields against which the external data can be referenced. These are typically:**
>
> - **person (identity of customer: name / address / date of birth)**
> - **location (full address-point / postcode)**
> - **insured asset (for motor insurance this could be registration number, or make / model code, as issued by the ABI in the UK).**

Section 6

The sub-section headed 'Non-proportional expenses' (at the end of section 6) has been deleted in its entirety.

Section 8

The sub-section headed 'References', at the end of Section 8, has been updated, and now reads as follows:

References

[Interested students can refer to these books for further information; however only material included in the Core Reading is examinable.]

Jørgenses, B., De Souza, M.C.P, *Fitting Tweedie's Compound Poisson Model to Insurance Claims Data,* 1994, Scandinavian Actuarial Journal, 1:69–93.

Duncan Anderson et al, *A Practitioners' Guide to Generalized Linear Models – A foundation for theory, interpretation and application, 2007*.

Summary

The summary at the end of the chapter has been updated in light of the above changes.

Chapter 18

Section 1

On page 4, just before the heading 'Example', the following paragraph of Core Reading has been added:

The initial sections within this chapter cover the theory and statistical approaches towards credibility theory. However, given some of the practical challenges outlined in Section 6, it is common to utilise more simplistic approaches in practice. In the Lloyd's and London Market, for example, a more subjective approach is often needed due to the type, volume and granularity of the data presented.

Section 2.2

On page 11, the fourth paragraph, which is just before the table, has been changed slightly to read:

Here is a table showing P for different expected numbers of claims n and for different values of proportion k :

Chapter 19

Section 3.2

The first paragraph on page 22 has been deleted.

Chapter 20

Section 6.4

Some changes have been made to this section. Please replace pages 35 to 38 with replacement pages 35 to 38a provided at the end of this Upgrade.

Glossary

The following definitions have been amended:

Accumulation of risk

An accumulation of risk occurs when a single event can give rise to claims under several different policies (for example in property insurance), or to claims from many risks covered under the same policy (for example in employers' liability).

Cape Cod method

The Cape Cod method uses the historical experience of some or all origin years as implied by the chain ladder method, adjusted for rate changes and claims inflation. More weight is given to years which the incurred chain ladder method suggests are more developed and where the exposure (usually measured by premium written) is higher.

Stop loss reinsurance

An excess of loss reinsurance that provides protection based on the total claims, from all perils, arising in a class or classes over a period. The excess point and the upper limit are often expressed as a percentage of the cedant's premium income rather than in monetary terms; for example, cover might be for a loss ratio in excess of 110% up to a limit of 140%.

No new definitions have been added and no existing definitions have been removed. There have been no changes to the list of abbreviations.

2 Changes to the X Assignments

Overall

There have been minor changes throughout the assignments.

More significant changes are listed below.

Assignment X1

Question X1.1

This question has been reworded as follows:

> You are the pricing actuary for an insurer that is about to begin writing household property (buildings and contents) insurance for the first time. You have been asked to devise a rating structure for this class. List the rating factors that you are likely to want to make use of. [4]

Question 1.8

The word 'developed' has been deleted from the first sentence of the question.

Assignment X4

Question X4.5

'State and explain' has been replaced with 'Describe'.

Assignment X6

Question X6.1

This question has been slightly reworded as follows:

> State four important factors that would determine the level of ceding commission paid on a motor quota share reinsurance policy. [5]

Question X6.9

The first sentence of this question has been slightly reworded as follows:

> You have been asked to build a catastrophe model to assist general insurers in the management of flood risk for their domestic household insurance exposures in a developed country.

3 Other tuition services

In addition to the CMP you might find the following services helpful with your study.

3.1 Study material

We also offer the following study material in Subject SP8:

- Flashcards
- Revision Notes
- ASET (ActEd Solutions with Exam Technique) and Mini-ASET
- Mock Exam and AMP (Additional Mock Pack).

For further details on ActEd's study materials, please refer to the 2022 *Student Brochure*, which is available from the ActEd website at **www.ActEd.co.uk**.

3.2 Tutorials

We offer the following (face-to-face and/or online) tutorials in Subject SP8:

- a set of Regular Tutorials (lasting a total of three days)
- a Block (or Split Block) Tutorial (lasting three full days)
- an Online Classroom.

For further details on ActEd's tutorials, please refer to our latest *Tuition Bulletin*, which is available from the ActEd website at **www.ActEd.co.uk**.

3.3 Marking

You can have your attempts at any of our assignments or mock exams marked by ActEd. When marking your scripts, we aim to provide specific advice to improve your chances of success in the exam and to return your scripts as quickly as possible.

For further details on ActEd's marking services, please refer to the 2022 *Student Brochure*, which is available from the ActEd website at **www.ActEd.co.uk**.

3.4 Feedback on the study material

ActEd is always pleased to receive feedback from students about any aspect of our study programmes. Please let us know if you have any specific comments (*eg* about certain sections of the notes or particular questions) or general suggestions about how we can improve the study material. We will incorporate as many of your suggestions as we can when we update the course material each year.

If you have any comments on this course, please send them by email to **SP8@bpp.com**.

- **There will be an associated cost to the original insurer of the risk transfer, which will depend on the current risk appetite of the market. This cost would be any premium payable plus the 'lost' investment income.**
- Any required court approval may be time-consuming and expensive, and may not necessarily be obtained.
- The new insurer may be exposed to the future emergence of new latent claims on the portfolio which may not have been anticipated / allowed for in the LPT calculations.

The 'premium payable' referred to above is an amount to compensate the new insurer both for taking on the risk and for expenses associated with the transfer. This would be paid on top of the value of the reserves. The 'associated cost' referred to is therefore this premium plus the value of any investment income effectively lost if the transferred value of the reserves uses a discount rate which turns out to be too low.

7 Capital market products

7.1 Types of capital market products

In this section we discuss products where risk is transferred to the capital markets rather than insurance markets. We will discuss the following products:

- committed (or contingent) capital
- securitisation and structured finance.

7.2 Committed (or contingent) capital

Committed capital or contingent capital is based on a contractual commitment to provide capital to an insurer after a specific adverse event occurs that causes financial distress. The insurer purchases an option to issue its securities at a predetermined price in the case that the defined situation occurs, on the understanding that the price would be much higher after such an event.

If the defined event occurs, leading to financial distress of the insurer, then the price of the insurer's securities will fall (*ie* it will be more expensive to raise capital by issuing securities). The option will allow the insurer to sell its securities after the adverse event at a higher price than their market price.

Example

If the securities have a current market value of \$100, then the insurer might fix the predetermined price (*ie* the strike price of the option) at \$100. Following the adverse event, the market value of the securities might fall to \$80. However, the insurer will still be able to issue such securities at the higher price of \$100.

There may be one or more triggers that have to occur before the option can be exercised, in order to avoid moral hazard.

Contingent capital provides a mechanism of ensuring that, should a particular risk event happen, capital will be provided. As such, it is a cost-effective method of protecting the capital base of an insurance company. Under such an arrangement, capital would be provided as it was required following a deterioration of experience (*ie* it is provided when it is needed).

7.3 Securitisation and structured finance

You may have met securitisation in an earlier subject.

Purpose of securitisation

Securitisation has two main purposes:

- Risk management – to transfer insurance risk to the banking and capital markets.

  It is often used for managing risks associated with catastrophes, as the financial markets are large and capable of absorbing catastrophe risk.

It involves turning a risk into a financial security, *eg* as in a catastrophe bond.

- Capital management – to convert illiquid, inadmissible assets into liquid admissible assets, hence improving the balance sheet.

  Almost any assets that generate a reasonably predictable income stream can in theory be used as the basis of a securitisation. Examples of illiquid assets that could be securitised are:

  – future profits, *eg* on a block of in-force insurance policies
  – mortgages (and other loans).

  Each of these could be securitised into tradeable instruments (*eg* bonds), in order to raise capital. The owner of the assets issues bonds to investors (*eg* pension funds, insurance companies and banks) and the future cashflow stream generated by the secured assets is then used to meet the interest and capital payments on the bonds.

  There is typically risk transfer as the repayments on the bonds are made only if, for example, the future profits emerge or mortgage repayments are made.

Example

A portfolio of mortgage loans owned by a bank could be pooled together and the cashflows from these mortgages used to service the interest and capital payments on a bond. Securitisation of this type that had been backed by sub-prime mortgages in the US, was the focus of much attention during the sub-prime crisis and credit crunch.

Operation of securitisation

In simple terms, a securitisation works as follows:

1. An investor purchases a bond from the insurance company and therefore provides a sum of money to the insurer.
2. The repayment of capital (and possibly of interest) is contingent on:
   – a specified event *not* happening, *eg* an earthquake measuring 6.5 on the Richter scale *not* happening, or
   – the portfolio of insurance business (upon which the bond is securitised) producing adequate profits.
3. If the event does happen (*eg* the aforementioned earthquake occurs), or inadequate profits are made from the securitised business, the insurer may default on the interest and capital payments due under the bond:
   – in the case of securitising a particular risk, the insurer can use the sum of money provided from the investor (in purchasing the bond) to cover the cost of claims arising from the earthquake
   – in the case of securitising a block of business, the poor experience of the business has been passed directly to the investor.
4. If the event does not occur or the business makes adequate profits, the investor gets their interest and capital back in the normal way.

In practice, the direct link between the investor and the issuer is broken by a special purpose vehicle (SPV), which is a separate legal entity that sits between the parties. Where it is a portfolio of business that is being securitised, the securitised assets are transferred into this vehicle.

Question

Explain why a special purpose vehicle is used in practice.

Solution

The existence of a separate vehicle with separate ownership of the securitised assets provides better security and greater transparency for investors in the securitisation.

This may seem like a particularly high-risk investment. It is. However, as long as the expected return on the investment is commensurate with the investor's required (risk-adjusted) rate of return, then a market for such an investment will exist.

The rationale is that insurance catastrophe risk or the risk of underperformance of the securitised business, is not correlated with investment market risks and so there is a benefit to the capital market in the diversification of risk achieved in purchasing such investments.

The banking and capital markets are used because of capacity issues and because the risks involved are ones with which the banking and capital markets are comfortable.

A key point to note about securitisation is that it is making insurance products look much more like banking products. The reverse, often called *insuritisation*, is making banking products look more like traditional insurance.

We now look at three specific types of securitisation:

- insurance-linked securities
- credit securitisation
- motor securitisation.

Insurance-linked securities (ILS)

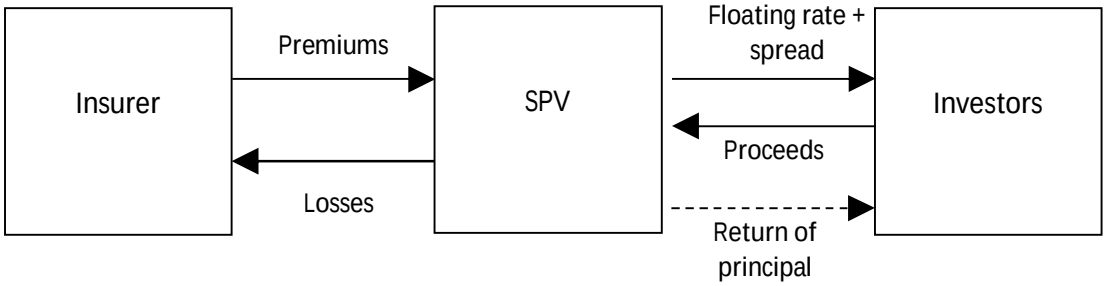
Insurance-linked securities (ILS) are an innovative way of increasing (re)insurance capacity. The valuation and performance of these financial instruments are driven by the occurrence (or lack of occurrence) of insurance loss events. ILS offer acquirers (such as institutional investors and pension funds) an opportunity to invest in instruments, the returns from which are largely uncorrelated with other financial assets and macroeconomic movements, and allow them to exclude surrounding risks (such as the market risk in share prices) of investing in reinsurance companies. For purchasers, who are typically insurers or reinsurers, ILS provide an additional source of protection and insurance risk mitigation instruments.

From the launch of the first securitisation in the 1990s, the ILS market has grown and cemented its place as a complementary alternative to reinsurance, notably in the property catastrophe reinsurance market. It has developed into what is now a reasonably liquid catastrophe (cat) **bond market. These catastrophe bonds allow (re)insurers to transfer high severity low probability catastrophic risks to the capital market and spread them among many investors: if the specified catastrophic risk is triggered, the bondholders typically forfeit the interest and principal on the bond to the (re)insurer. If there is no catastrophic event, or trigger event before the maturity date of the contract, investors receive back their principal investment at maturity on top of the interest payments they have received.**

You may be confused by the fact that the (re)insurers are referred to as 'purchasers' in the first paragraph of Core Reading above. This is because an ILS involves a corporate entity called a Special Purpose Vehicle (SPV) that sits between the (re)insurer and investors.

An SPV is a subsidiary established by a company to 'fence off' financial risk. The SPV is bankruptcy-remote from the parent company – in other words the bankruptcy of the parent doesn't affect the SPV and vice versa.

For example, a typical cat bond structure would be:



As shown in the diagram, the investors purchase the bonds but the (re)insurer pays premiums to the SPV to purchase the protection afforded by the contract. It is more common to refer to the (re)insurer as the 'sponsor' of the ILS rather than the 'purchaser', to avoid any confusion.

Cat bonds developed primarily in response to the hard market (*ie* high premiums) of traditional catastrophe reinsurance in the 1990s.

There can be many variations, and many types of trigger event.

The basic advantages of ILS are that they:

- increase insurance capacity by transferring risk to the capital markets
- mitigate counterparty risk as funds are held in a secure independent vehicle.

Credit securitisation

Although not usually involving reinsurance, insurance companies have been active in the credit securitisation markets.

Their main roles have been:

- **enhancing the creditworthiness of debt instruments**
- **providing capital relief to banks by insuring loan portfolios**
- **providing credit protection to companies.**

Enhancing the creditworthiness of debt instruments / providing capital relief to banks

Consider a bank securitising some of its loan portfolios. The interest and capital repayments under the loans will be securitised and used to pay the interest and capital repayments under the debt instruments (*ie* bonds).

Investors will require a return on the bonds that is adequate to compensate them for the risk of default. The bank may want to keep the return on the bond as low as possible, therefore it must try to ensure that the bond is relatively secure. In order to do this, it must either securitise its best quality loans (*ie* the loans with the lowest risk of default), or it must securitise a large number of loans relative to the number of bonds issued (in which case, even if the loans default, there will still be an adequate number of bonds left with which to make payments on the bonds).

The first of these options may not be available if the bank does not have (or has already securitised) a portfolio of 'safe' loans. The second option may be undesirable, because effectively, the bank is using up a lot of its business in the securitisation, which will reduce its profits.

A third option is to use insurance to reduce the credit risk of the bonds. The bank insures the bonds so that their return is guaranteed (as long as the insurer does not default). If the payments under the loan portfolio are not sufficient to meet the interest and capital payments under the bond, then the insurance will kick in and make the payments to the investors.

Having insurance as an underlying guarantee will enhance the creditworthiness of the debt. This will help to ensure that the bank does not need to pay a very high rate of return on the bonds, or, equivalently, does not need to sell them cheap. It should therefore be able to sell the bonds at a relatively high price, thus maximising the capital relief provided by the securitisation. This needs to be weighed up against the cost of insuring the bad debt.

This type of arrangement falls into the category of capital management, as described above.

Providing credit protection to companies

There are numerous types of credit securitisation arrangements, although the basic contract is a *credit default swap*, which is essentially an agreement to compensate the 'insured' (*ie* the buyer of the swap) if a specified credit event occurs (*eg* bankruptcy or loan default of another company).

Note that for each of these arrangements, the insurer is not usually one of the two parties involved in the securitisation itself. Instead, it is a third party providing insurance against the risk of default by another party.

These alternative risk transfer (ART) solutions use derivative products available in the capital markets, in addition to variations on traditional trade credit insurance.

Motor securitisation

Another capital market product is motor securitisation (where certain aspects of a motor insurer's portfolio risks are passed to the investment market).

The insurer issues a bond where the coupon payments depend on the claims experience of the insurer's motor portfolio. If the insurer experiences poor claims experience, it may forego some or all of its repayments. Thus, the insurance risk is transferred to the capital markets instead of to the reinsurance market.

As with other debt issues, these bonds are tradable financial instruments.

Structured finance

The term 'structured finance' is sometimes used interchangeably with 'securitisation'. However, it is also used to refer to a broader class of financial arrangements designed to transfer risk using complex legal and corporate entities.

Reinsurers became involved in structured finance through their finite reinsurance business and the increasing need of financial guarantee insurers and investment banks for additional capacity.

The typical financing solution provided by the reinsurer is a credit enhancement in which the reinsurer provides a financial guarantee or credit insurance wrap to the institution borrowing from the capital market.

Credit enhancements involve insurance companies insuring loan portfolios or providing credit protection to companies to improve the creditworthiness of debt instruments. These solutions use derivative products available in the capital markets, in addition to variations on traditional credit insurance.

Credit insurance wraps are insured or guaranteed by a third party. The third party may provide a promise to reimburse losses up to a specified amount. The third-party guarantees are typically provided by AAA-rated financial guarantors.

Credit enhancement or financial guarantees lower the cost of borrowing.

3 Climate change and environmental factors

The natural environment leads to many insurance claims, including some of the most spectacular ones. Recent concerns about climate change have raised the prominence of this issue, but normal trends in weather and the incidence of spectacular events mean that weather-related losses are inherently unpredictable from year to year. The human-made environment can also be a cause of claims in ways that are not always obvious in advance.

This section covers:

- the impact of the weather, including seasonal effects (which will depend on characteristics of the property being insured), and the possible implications of global warming
- catastrophes, including weather-related events (particularly hurricanes), and factors affecting the financial impact of these; earthquakes and examples of human-made catastrophes are also discussed
- latent claims, giving lots of examples, and how insurers have tried to deal with latent claims.

3.1 Weather

Seasonality

The most obvious way in which weather varies, in most countries, is seasonality. In temperate climes there is the spring / summer / autumn / winter pattern; in tropical climes there may be a dry season / wet season pattern or a monsoon season. The precise pattern and the dangers associated with each phase will vary from country to country even within geographic zones, with differences in weather patterns and building codes, among other things.

Building codes are the standards to which houses, offices, bridges, *etc* must be constructed. For example, in territories prone to earthquakes, such as California and Japan, there are regulations to ensure that all new buildings are built to standards to withstand earthquakes of a specified intensity.

In areas where the standard of building construction is high, insurers should bear lower losses.

In general, winter weather is harsher and for some classes is more likely to give rise to claims: storm damage is more likely and driving conditions are likely to be more treacherous, including the fact that there are fewer hours of daylight. This is rarely of concern to insurers, since most policies are issued for a year and will be in force through all four seasons. However, in extreme cases it may influence patterns used to earn premiums, *eg* catastrophe reinsurance in the US.

The unearned premium reserve (UPR) is usually calculated by taking a portion of premiums in respect of the unexpired exposure period. Often, this is done on a straight averaging basis, *eg* for an annual policy with six months to go it might be reasonable to take half of the premium. However, if the risk is not uniformly spread over the year of cover, *eg* where the claim costs vary according to the time of the year, the proportion of premium taken should reflect the expected risk in the unexpired period.

In calculating UPR, an allowance might be made for initial expenses. The calculation of the UPR is discussed in detail in Subject SP7.

Subsidence and land heave

Although the weather in summer is generally more benign than in winter, the problems of subsidence of buildings and heave are generally more likely to arise in the summer, particularly when it's very dry and hot. The shrinkage of land on which houses are built as the ground becomes desiccated (dries up) **leads to damage to the houses, which is exacerbated when the drought breaks and the ground expands again. This can lead to a large number of claims for structural damage to property, especially domestic property, many of which can be large. Also, when the damage is not caused over a short period of time, as it might be with a storm, catastrophe XL reinsurance may not respond to these losses.**

Heave is essentially the opposite of subsidence. Whereas subsidence involves a downward movement of land due to a reduction in hydration, heave involves an upward movement due to increased soil hydration. Heave could occur after trees are felled in an area because they will no longer absorb moisture from the soil.

Question

Suggest why the catastrophe XL (excess of loss) reinsurance may not have covered many of the subsidence claims.

Solution

Catastrophe excess of loss reinsurance covers catastrophic events. An event is defined as a number of claims occurring within a short period of time (defined in the hours clause in the reinsurance treaty). Many subsidence claims will have been deemed to occur outside of this period, and so would not be counted in the total claim amount used to determine the reinsurance recovery.

Location of property

Different areas are obviously subject to different climates, but the vulnerability of particular properties to weather events will vary in ways that are not always obvious, and make underwriting difficult for a mass product. Places close to each other will suffer almost the same weather, but some locations are more sheltered than others, and some will be more prone to being flooded. Obviously, properties built on flood plains are prone to flooding, as are those on low-lying lands near the coast, but other vulnerable places may not be so obvious: where water is channelled as it runs downhill it may make some hillside properties vulnerable to flooding.

So two properties might be in the same small town but have a very different weather-related risk because:

- one is in a sheltered, dry spot under a hill
- the other is in an exposed area, next to a river.

Some insurers are dealing with this issue by, for example:

- requesting more precise details about the location of the property and previous claim history
- rating according to a more precise measure of location – *eg* using full postal code, rather than just the first few characters.

Climate change

Climate change refers to long-term changes in average weather patterns. Scientific consensus has linked climate change to the rise in average global temperatures due to human activity associated with greenhouse gas emissions.

Climate change is anticipated to significantly impact the availability, affordability and demand for (re)insurance in the coming years. Climate change is expected to result in increased intensity and frequency of extreme weather events such as heatwaves, heavy precipitation, droughts, flooding, and tropical cyclones.

The term 'tropical cyclone' refers to a storm system comprising a large area of low pressure at the centre together with thunderstorms that result in heavy rain and fast winds. Tropical cyclones can be subdivided based on location (and strength) into typhoons (northwest Pacific), hurricanes (northeast Pacific and northern Atlantic), tropical storms or tropical depressions.

The increased hazards could lead to increased claim costs and affect the insurability of some types of risks, regions and lines of business. For example, as the sea level rises and the risk of flooding increases, some coastal areas may become uninsurable. Similarly, existing infrastructure built without sufficient consideration for resilience to climate risks may also become more expensive to insure.

If properties in some areas become substantially more vulnerable to loss, to the extent that their owners struggle to find insurance cover, this may lead to political issues.

Many people feel that governments have a moral obligation to protect householders from flooding. This is demonstrated through state-funded construction of flood defences, such as the Thames barrier in London. In some territories, such as France and the United States, flood protection is provided through government insurance or pooling arrangements. In others, such as the UK, if flood defences fail or are inadequate, the householder may be left paying, and so will need to buy private insurance.

A concern in the UK has been that those on low incomes may be unable to afford home insurance, *eg* if they live in low lying properties or coastal areas.

Therefore, the UK government and the insurance industry have set up a fund called Flood Re, to provide affordable flood insurance to high-risk policyholders by taking the flood risk element of home insurance from an insurer in return for a premium based on the property's Council tax band.

In other words, the policyholder buys home insurance from an insurer as normal, but the flood risk element of the policy is covered by Flood Re.

Flood Re is financed by a levy on all insurers relative to their share of the home insurance market.

Question

Climate change is seen as a long-term effect. Suggest some short-term measures that general insurers could take each year in response to the resulting adverse claims experience.

Solution

A general insurer could respond to adverse claims experience by:

- increasing premiums, either overall or for certain risks
- changing its benefits, *eg* exclude specific perils
- strengthening underwriting or claims control measures
- no longer selling certain products
- revising its target market, *eg* stopping marketing activities in certain locations
- strengthening its reinsurance programme, where this is feasible.

Beyond the physical risks, insurers also face transition and additional liability risks from efforts directed towards mitigating climate change. These risks may become more pronounced as the world moves towards a low carbon economy aimed at minimising greenhouse gas emissions. As a result, insurers may experience a change in risk profiles and emergence of new risk types. For example:

- **changes in commercial risks due to adoption of more sustainable manufacturing processes**
- **changes in motor liability risks due to replacement of fossil fuels with renewable energy sources**
- **increased product liability risks from adoption of technological high energy storage batteries which have a high risk of overheating and explosion**
- **pressure to withdraw insurance support from companies in the fossil fuel sector, *eg* coal producers and oil companies**
- **emergence of liability risks for insurers manifesting as litigation against existing policyholders for failure to mitigate, adapt and disclose climate risks they faced.**

Climate-related risks to the insurance industry can be separated into three categories:

- physical risks
- transition risks
- liability risks.

A physical risk is one due to extreme events caused by climate change. For example, the risk of an increased frequency of hurricanes leading to increased insurance losses.

A transition risk is one associated with society's transition towards a low-carbon economy. For example, the risk that government policies implemented to reduce global warming might reduce the value of assets held by an insurer, *eg* holdings in fossil fuel companies.

Liability risks are ones associated with compensation claims for losses due to physical or transition risks. For example, the risk of increased losses in Directors' and Officers' insurance due to claims against companies (*eg* electricity providers) for failing to consider climate change in their strategy.

Reinsurance availability is also likely to change. For example, reinsurers may increase their rates and place caps on exposures from particular perils or regions reducing the availability of cover. If an insurer relies on reinsurance to provide cover for large risks or significant accumulation risks, then the insurer's underwriting capacity may be diminished.

3.2 Catastrophes

Catastrophic losses can take the form of one immense loss, such as an oil-rig explosion. Alternatively, there may be many smaller insured losses, all stemming from a common, identifiable event such as a hurricane.

One way to reduce the impact of catastrophic losses is to write business in a wide range of geographical locations and across many classes. Catastrophe reinsurance will also help.

Catastrophes may be either natural or human-made in origin.

Examples

Natural catastrophic losses include:

Ice, snow, frost: Widespread property damage may arise from water damage caused by burst pipes. There will also be many more claims for accidents from a motor account.

Storms: Severe storms (*eg* wind, hail or rain) can cause extensive damage to property. There may be a large number of claims from agricultural or motor policies in a region hit by a hailstorm or household property damage from wind storms or flooding (*eg* parts of the UK in the winter of 2015).

Earthquake: Potentially massive damage to property classes (*eg* Los Angeles earthquake in 1994).

Fire: Large fires can cause extensive property damage (*eg* Australian bushfires in 2019-2020, largely ignited by lightning). These are most often seen in hot, dry territories. Catastrophic fires can also be human-made, *eg* due to accidental or deliberate ignition.

Human-made catastrophic losses include:

Air crash: *Eg* Shoreham Air Disaster (UK) in 2015. This could affect the aviation or public liability classes. If the problem is a design fault, claims could fall on the manufacturer's product liability cover.

Explosion: *Eg* container storage station at the Port of Tianjin (China) in 2015, oil depot at Buncefield (UK) in 2005, the Piper Alpha oil rig in 1988. Losses could hit property, employers' liability, public liability and/or consequential loss policies.

Terrorism: *Eg* terrorist attacks on the World Trade Centre in New York on 11 September 2001.

Hurricanes, storms

Although the US is cited for having the most expensive weather incidents, more recently, events in New Zealand, Australia and SE Asia have reminded us that 'weather' is a worldwide phenomenon.

The pre-eminence of the US in this regard is partly because of the concentration of high insured risks (*ie* properties with high values) **and partly because of the vulnerability of the coast of the Gulf of Mexico and the Atlantic states' littoral area to hurricanes.**

Littoral means pertaining to the coast.

As mentioned before, the high total cost of insurance claims from weather-related events in the US compared to other countries can be partly attributed to:

- the large number of properties in certain areas, particularly in cities along the eastern coast
- the high proportion of properties that are insured
- the high average value of these properties.

In addition, the US states of Alabama, Florida, Georgia, Louisiana, Mississippi, North Carolina, South Carolina and Texas are particularly prone to hurricanes.

It is normal seasonal behaviour for tropical storms to form over the Atlantic Ocean and track in a westerly direction, some forming hurricanes in the Caribbean, the Gulf of Mexico and on the US's south-eastern coast. They tend to cause damage – sometimes very serious damage – in Caribbean states, but the concentration of insured values there is low. Whether or not they are serious events in global insurance terms depends partly on their strength, but more on whether they affect the US and where in the US they land.

The most expensive weather incident ever recorded (at the time of writing) **is Hurricane Katrina, which hit Louisiana in the autumn of 2005. Although it was a very strong storm it was not uniquely strong, and not in fact the strongest storm to hit the US in 2005 (that was Hurricane Wilma slightly later that year). However, Hurricane Katrina passed almost precisely over the city of New Orleans, which proved to be particularly vulnerable. This type of effect adds to the uncertainty of underwriting property insurance in loss-prone areas.**

Part of the reason for there being such extensive damage was that Hurricane Katrina weakened a main levee (breakwater) protecting New Orleans. Six days later the levee broke, resulting in flooding to approximately 80% of New Orleans and subsequent loss of lives, damage to property and much looting in and around the city.

Rising cost of major losses

It has been observed that the cost of major losses has risen substantially. This is largely due to economic development. Some of the areas in the US most vulnerable to storm losses have been at the forefront of development. Florida is a major holiday destination, which has led to a great deal of development near the coast. It is also a low-lying state which makes it vulnerable to hurricanes.

Low-lying states are vulnerable to coastal flooding associated with hurricanes.

Another cause of increases in the cost of disasters is a general trend towards taking out insurance. Insurance cover is not universal even in developed economies; in less developed economies it can be the exception rather than the rule. However, in almost all countries property is more likely to be covered by insurance than it was some years ago. This means that the proportion of economic loss covered by insurance in any catastrophe is higher than it used to be. An obvious consequence of the difference in the proportions of properties insured in various places is that a catastrophic event in a less developed country can cause only modest insurance losses, whereas a similar event in a developed country can give rise to very heavy losses.

Earthquakes

Earthquakes are occasional events that may lead to heavy insured losses. Geological structures determine an area's vulnerability to earthquakes in general, and the most vulnerable areas are well known, although small events are not unknown elsewhere. Most areas of greatest vulnerability are areas of low insurance intensity, but there are important exceptions; notably Japan, including Tokyo, and the San Francisco and New Madrid areas of the US.

On the other hand, the Asian tsunami of December 2004 – caused by an offshore earthquake that was one of the largest ever recorded – caused about 230,000 deaths and widespread devastation, but relatively little insured loss. In March 2011, an earthquake hit the northeast coast of Japan, causing a 10-metre tsunami. Over 20,000 lives were deemed dead or missing and over 100,000 buildings were totally destroyed.

Other natural perils

Other natural catastrophe perils include flood, typhoon, hail and volcanic eruption.

In the UK the most important catastrophe perils are extra-tropical cyclones (windstorms) and flooding (including coastal surge, riverine and drainage related).

In some countries, there are nationally-administered insurance schemes that may effectively provide some or all of the cover for certain catastrophe perils.

Human-made catastrophes

Human-made catastrophes consist mainly of terrorist incidents, industrial accidents and conflagrations.

A conflagration is a large destructive fire, which can be difficult to control.

Terrorism may or may not be covered by insurance, depending on local practice and law. Terrorist incidents give rise mainly to property damage claims but may give rise to liability claims if security measures are found to have been inadequate.

In some territories, such as in the UK, claims arising from terrorist attacks are covered by government-backed arrangements. In these circumstances, insurance contracts tend to specifically exclude claims resulting from terrorism. (In some cases, such as in the UK prior to the 2001 WTC attacks, insurers would cover claims up to a specified monetary limit, and the government-backed arrangement would pay claims in excess of this.)

3.3 Latent claims

Latent claims derive from perils that were unforeseen when the policy concerned was signed. Students should note, however, that the term is also applied to any insurance claims that become known some years after the cause of loss. Most of these arise from diseases caused by products or industrial processes, but faulty construction of buildings is another possibility. Claims arising from the sexual molestation of people, particularly children, is another example.

Most latent claims will therefore arise under product liability and employers' liability insurance. This is not necessarily the case however. Faulty building construction could probably be covered under architect's professional indemnity insurance or a contractor's construction all risks (CAR) cover. Child sex abuse claims may arise under public liability insurance.

Examples of types of latent claim

The most notorious classes of claims of this nature are those arising from asbestos.

Claims arising from exposure to asbestos in the US alone have been projected to cost insurers $200 billion.

Numerous employers' liability (and some product liability) claims are arising in respect of workers that handled asbestos materials and products. Although some of those affected were exposed to asbestos from as early as the 1940s, the resultant lung conditions (*eg* asbestosis and mesothelioma) did not begin to materialise until about 1980.

Some other latent claim classes are listed below. These include claim causes that appear to have run their course, others that are still in the process of manifesting themselves and others that have caused concern, but may or may not develop into significant sources of loss:

- **Agent orange.**

  This was a chemical defoliant that was sprayed over Vietnam by the US army in the 1960s. Many of the soldiers based there have sued against the manufacturers of the chemical for consequent health problems to themselves and their families (*ie* for birth defects). Most of these claims were made in the 1980s. More recently (2006), Vietnamese victims have tried unsuccessfully to make claims.

- **Radiation from mobile phones.**

  It has been suggested that this might be linked to an increased risk of some cancers (particularly in children), headaches or sleeping problems. To date, no definite link has been proven, but research continues.

- **Benzene.**

  Exposure to benzene can cause serious health problems, including some cancers. The chemical has been found in some carbonated soft drinks, which were, of course, immediately withdrawn from sale.

- **Diethylstilbestrol** (DES).

  This is a drug that was given to millions of women in the US in the middle of the 20th century to reduce the likelihood of premature births. However, it has been linked to genital abnormalities in daughters, and even potentially in granddaughters.

- **Electromagnetic fields.**

  These are linked to the increased risk of leukaemia and other cancers.

- **Pollution.**

  Exposure to pollution may last several months or years. The impact on health of being exposed to polluted conditions may not be apparent for many years.

- **Guns.**

  In the US, there have been attempted claims for compensation against gun manufacturers:

  – by victims of accidental shootings
  – by city councils, for the increase in gun crime
  – by gun users, where accidental injury has been caused.

  To date, most of these claims have been unsuccessful.

- **Noise-induced deafness.**

  Most commonly, this is due to working with, or being exposed to, noisy machinery (*eg* with pneumatic drills or beside aircraft).

- **Blood products infected with HIV or hepatitis.**

  During the late 1970s and early 1980s, large numbers of haemophiliacs became infected with HIV or hepatitis after receiving tainted blood-clotting substances.

- **Sick-building syndrome.**

  The building people work in can be blamed for a range of illnesses, such as irritation to the nose, throat and eyes, fatigue or headaches. This could be attributed to micro-organisms within the air conditioning or the humidity of the building, but the specific causes of these conditions are generally difficult to prove.

- **Latex gloves.**

  Some people are severely allergic to latex rubber. Examples of compensation claims are:

  – under employers' liability coverages, from hospitals sued by workers that have been made to wear latex gloves
  – under product liability coverages, from glove manufactures sued by customers wearing, or patients treated by medical staff wearing, latex gloves.

- **Lead paint.**

  Lead is added to some paint to improve its performance, *eg* in drying quickly. It can be damaging to health, in particular hindering the development of young children. Now that the dangers are known, it should only be used in certain circumstances, *eg* for painting road surfaces. There are potential product liability claims against paint manufacturers, and some public liability claims, *eg* against landlords.

- **Bovine spongiform encephalopathy (BSE)**.

  BSE is commonly known as 'mad cow disease' as it affects the brains of cattle. It was first found in the mid-1980s, mainly in parts of Europe. However, 10 years later a brain disease (known as vCJD) was found in humans, causing several deaths, and there is evidence to suggest that some victims may have caught the disease by eating meat from BSE-infected cattle.

- **Toxic mould.**

  There have been houses and other buildings in the US, particularly in Texas, where types of mould that emit toxins have been claimed to cause health problems and damage to property. Among the parties being litigated against are builders, architects and owners of buildings (such as schools).

- **Dalkon shield.**

  This is a contraceptive intrauterine device that was found to cause severe injury to a disproportionately large number of its users.

- **Repetitive strain injury** (RSI).

  RSI is a generic term used to describe a range of painful conditions of the muscles, tendons and other soft tissues. It can affect the upper limbs, neck, spine, or other parts of the musculoskeletal system. They are generally caused by performing work-related, usually repetitive, tasks, and so they can lead to employers' liability claims. Vibration white finger (from using vibrating machinery, such as pneumatic drills) is a traditional example, although conditions related to computer use (*eg* poor posture) are more prevalent nowadays.

- **Silica dust.**

  A fine silica dust can be produced when certain types of rock are cut, drilled, *etc*, which can cause lung diseases if inhaled. Foundry workers and people working with the products produced (*eg* potters and sandblasters) are most at risk unless proper precautions are taken. It can take, say, 10 to 15 years following exposure before symptoms develop.

- **Tobacco.**

  Smokers and their families have taken tobacco companies to court for illnesses, injury or death caused by long-term smoking. Most cases have been in the US, where some medical insurance providers have also claimed compensation from the tobacco companies.

- **Year 2000 computer systems.**

  Towards the end of the 1990s, there was a huge fear that many computer systems and products that relied on microprocessors would fail in the year 2000. This concern arose because early computer programs often use a two digit code for the year component of dates and the ambiguity of the date '00' may lead to incorrect calculations. Products that may have failed include computers, machinery, lifts and safety equipment. Failure on safety equipment may also have led to employers' liability claims. Companies and organisations all over the world checked and upgraded their computer systems in preparation for the 'millennium bug', and no significant computer failures occurred when the time came.

- **Nanotechnology.**

  Nanotechnology is the ability to work with materials on an extremely small scale, *eg* 100 billionths of a metre or less. This is still a developing field, but nanomaterials are already being incorporated into many products worldwide, including cosmetics, paints, medicines and food products. However, there is very little knowledge about how nanomaterials may affect the long-term health of workers and consumers.

  Any tort litigation arising from the alleged harmful effects of nanomaterials could impact manufacturers, distributors, secondary users (*ie* producers who incorporated nanomaterials into other products) and retailers. Insurers writing employers' liability, general liability and product liability could therefore be affected.

- **Opioids.**

  Opioids are a class of addictive painkillers regularly prescribed by doctors. They have been the subject of much controversy in the US where doctors have been accused of over-prescribing the drugs and pharmaceutical companies have been known to market their products aggressively to doctors and consumers alike. The resulting 'addiction epidemic' is taking thousands of lives annually and causing millions of dollars of economic losses. This has led to litigation against pharmaceutical manufacturers, distributors, pharmacies and general practitioners. The resulting insurance claims have impacted product liability, 'druggist liability' insurance (for pharmacies), errors and omissions policies, and general liability policies.

- **Sexual harassment / #MeToo movement**

  Sexual harassment cases have received a great deal of publicity in recent years, leading to a rise in related insurance claims. Denunciations are often made public early in proceedings, which can quickly lead to multiple claims. Claims could arise on several liability classes, *eg* D&O, public liability, employers' liability, general liability *etc*. However some reports suggest that most insurance claims are arising from employers' liability products.

- **Sexual molestation.**

  These cases are similar to the sexual harassment claims listed above, but probably relate more to child abuse or abuse of vulnerable people. In the context of latent claims, historical abuse is probably most relevant. (Note that the insurance would not benefit the perpetrator in these instances. Rather, the coverage is designed to protect institutions such as employers, schools, care homes, *etc* who are subject to defamation or litigation.)

Problems with latent claims

One problem with latent claims is that it is impossible to know where the potential claim is lurking. Also, if the claim does materialise, the future claim cost is completely unknown.

For example:

- Will there be future employers' liability claims for damage to people's eyes from using computers too much?
- If so, how much will the claim amounts be and how many people will be able to claim?

There is also the problem of identifying when exactly the claim event occurred, especially if exposure (*eg* to the harmful substance or working conditions) was over many years.

Most latent claims arise in liability insurance. The normal form of these policies was the occurrence basis in which a claim would always be paid from the year of account in which the damage was caused. This leads to problems of definition: if a person who worked with asbestos for a number of years, possibly with several different employers, contracts mesothelioma some decades later, how can it be traced to a particular year of insurance? The answer is that a legally-imposed or industry-agreed method of allocation must be found.

It may be difficult to identify the claim event date. However, the claim notification date should be readily identifiable and objective.

Partly as a response to this, the claims-made policy was developed in the 1980s. This is now the standard form of policy for professional indemnity insurance and some other liability classes. It is intended to cover all claims that were first notified in the year of insurance. However, the cover granted may be unsatisfactory from the claimant's point of view, and even more so from the point of view of a claimant who depends on the tortfeasor's insurance to obtain redress. When a claim arises, the tortfeasor may no longer exist, and if latent claims are emerging they may have trouble obtaining continued cover.

So, for example, say an employer took out liability insurance on a claims-made basis. If it is known that the employer exposed its workers to hazardous conditions, it will be difficult for it to get cover that is either affordable or comprehensive enough to cover future claims. This is because insurers will fear a large number of claims being notified in the coming year.

For reasons such as this occurrence cover may be required in areas where insurance is compulsory, such as UK employers' liability.

Liability insurance is intended to protect the insured against the cost of having to pay compensation, rather than to protect the third-party victim. However, such insurance is compulsory to ensure that victims can be compensated. It is therefore common for victims to be able to claim directly from insurers where the tortfeasor no longer exists, having ceased to trade for example.

Latent claims are covered in more detail in Subject SA3.

Solution

Examples include:

- a change in the propensity of individuals to report claims quickly – this may be a gradual change, *eg* due to longer working weeks (and so less free time to report claims)
- changes in processes of brokers regarding claims processing / reporting, for business sold through brokers.

Demand surge

Following a major catastrophe, there will be increased demand for goods and services in the affected areas.

For example, the demand for builders may increase following a flood. This increase in demand could force up the price for such goods and services to an unpredictable extent.

Higher prices could mean higher claim amounts.

Climate change

In the coming years, climate change is going to be a major source of risk and uncertainty for insurers, the extent of which will depend on whether there is a successful transition to a low carbon economy and hence avoidance of the full effects of unmitigated climate change. Insurers will need to reassess the extent to which they can rely on historical experience considering the significant impact climate change will likely have on future claims trends.

Historical occurrence patterns for weather-related claims may no longer be appropriate as climate change is expected to result in increased frequency and severity of extreme weather events to varying degrees in different areas.

Climate risk may introduce dependencies or 'ripple effects' across different risk types, regions or business classes. For example:

- **A flood event can also lead to business continuity and supply chain risks, further increasing uncertainty.**

  Potential increased frequency and severity of flood events could therefore be a common driver of worsening claims experience in a number of classes, where we might not previously have expected to see much correlation, *eg* trade credit insurance and household insurance.

- **An increase in sea level due to melting ice caps may lead to more losses in a region, causing mass migration and changes in economic activity levels with consequences for the availability and performance of investment assets.**

  Hence, amongst other things, climate change could lead to added dependency between insurance risk and market risk.

Bodily injury claims

Some governments have introduced legislation concerning the payment of bodily injury claims. The idea is that to indemnify the policyholder, the claim payment should be in the form of income replacement, in addition to any lump sum. This effectively places a life liability on the insurer, which introduces additional uncertainty.

Incorporating the future incidence and quantum of these types of awards will lead to additional uncertainty in the setting of premiums.

Differences in third party behaviour

The behaviour of third parties may also impact claim characteristics for certain classes.

For example, lawyers may actively seek out people affected by asbestos-related illnesses. This would increase the claim frequency, and may also have an effect on severity.

Question

Suggest how claim severity might be affected by this.

Solution

If lawyers seek out people who have been affected by asbestos-related diseases, there may be a general increase in awareness and/or an increase in publicity over asbestos cases. As a result, there may be an increase in awards made by courts over asbestos-related claims.

On the other hand, those with less severe conditions may be more likely to make claims, which could lead to a reduction in average claim sizes.

Government legislation

Relevant legislative actions can be divided into three main types:

- Tax changes, *eg* an increase in value-added tax (VAT). Many claims are settled on a replacement basis (*ie* the insurer replaces the damaged item), so if the VAT on the insured item increases, the cost of replacing that item will increase and the claim cost will increase.
- Changes in the law that increase the amount of cover being provided, such as removal of a legal limit on compensation levels.
- Changes in the law that restrict or forbid the use of certain factors in underwriting.

In the first two cases, an insurer is unlikely to have foreseen such changes. Since premiums cannot be changed retrospectively, the changes will adversely affect profits until some time after the premiums or cover can be adjusted. The third type of change will be known about in advance, but may expose the insurer to anti-selection for which the cost cannot be accurately assessed. This may result in the need for higher premiums to allow for this risk.

The introduction of new legislation, such as 'Treating Customers Fairly' in the UK, may reduce an insurer's ability to use certain rating factors / levels of price change, which may lead to a reduction in ability to charge adequate premiums for the risk being accepted.

The effect of economic conditions on claims

Changes in economic conditions could influence claim propensities, particularly within Personal Lines.

Economic conditions can also affect the timing and severity of claims. There is therefore a continuing uncertainty as to the number and cost of the claims that will occur when conditions change.

Mortgage indemnity is one class that is heavily affected by economic conditions.

A number of economic variables could have a direct impact on claims. For example:

- inflation – this will directly affect claim amounts

Question

Outline three types of inflation that can affect claim amounts.

Solution

1. price inflation, which will affect the replacement costs of goods
2. earnings inflation, which will affect repair costs and loss of earnings claims
3. court inflation, which will affect claims that are settled in the courts

- unemployment – this could lead to certain sections of society being unable to afford insurance, and so produce a different mix of business
- economic growth – this could lead to more sections of society being able to afford insurance (and higher levels of cover in some cases), and so produce a different mix of business
- exchange rates – **there will be additional uncertainty as a result of future exchange rate movements, if it is likely that claim payments would be in a different currency from the premium payments.**

  For business transacted in a currency other than that of the country in which the insurer is based, there is a risk that the insurer's results will be adversely affected by changes in the exchange rate between the two currencies; there will also be uncertainties stemming from currency mismatching between assets and liabilities, and because it may be impossible to predict the currency in which a claim will have to be settled.

Question

Give three examples of general insurance classes in which there is likely to be a high level of uncertainty relating to the currency of the claim payments.

Solution

Marine, aviation and travel.

These are probably the most obvious but you could also mention product liability, commercial motor etc.

In addition, the economic conditions can have a wider impact on the environment; for example, crime rates may increase during recessions.

The rates of crimes such as theft and arson have shown considerable variation from year to year and from country to country. General insurance companies might actively engage in trying to encourage policyholders to take steps to reduce crime, in the hope of reducing claim costs.

1.2 Internal sources of process uncertainty

Planned or unplanned changes in mix

Different risks will exhibit different claims characteristics, *eg* claim frequency, severity, volatility, timing of payments *etc*. The degree of uncertainty inherent in the business will therefore depend on the mix of risks that have been written.

In addition, any changes in the mix of business will increase this uncertainty.

Question

(i) Suggest possible strategies that might lead to a change in business mix.

(ii) Suggest other reasons why the business mix might change.

Solution

(i) ***Strategies leading to a change in business mix***

- strategic change in target market
- change in distribution channels used
- change in marketing method
- change in pricing structure
- change in underwriting processes
- change in claims handling procedures

(ii) ***Other reasons why the business mix might change***

- increase in anti-selection by policyholders
- change in the attitude to claiming
- change in fiscal regime, *eg* tax relief on certain groups of policyholders buying insurance
- change in regulatory regime, *eg* certain types of insurance becoming compulsory
- change in company reputation, *eg* a company becoming seen as a budget provider

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New markets

Entering a new market or territory will incur expenses for the insurer, including set-up fees, accommodation costs, fees to the regulator and legal costs. It may not be acceptable within the market to pass on these fees directly to the policyholders, if other insurers have a lower expense base.

The expenses of entering a new market are uncertain and there is uncertainty as to the extent to which those expenses can be passed on to customers, due to the need to remain competitive.

New distribution channels

Claims frequency, severity and development may be expected to vary by distribution channel.

If the use of a new distribution channel tends to attract policyholders with different characteristics from those of the existing clientele, the resulting claims experience may differ from that of the past in an unpredictable way.

For example, direct sales may be expected to develop more quickly than broker sales if claims from broker sales are reported through the broker. They may also be less frequent if the broker has a process to filter out any fraudulent claims.

The internet is now the dominant sales channel for personal lines and smaller retail products. The lack of a face-to-face meeting or a telephone call when buying a policy certainly increases the possibility of fraud, which will affect frequency and severity of claims.

The number of distribution channels is likely to increase in the future, as insurers pursue ever more innovative ways of attracting new business and reducing costs.

New channels may also create a knock-on effect on existing channels. For example, if the internet channel increases, the broker channel may shrink to compensate, resulting in brokers offering incentives to attract business.

New claims handling procedures

An example of a new claims handling procedure is reflected by the fact that some insurers offer an online claims reporting service. This may increase policyholders' propensity to claim, thereby increasing claim frequency. It may also cause an increase in fraudulent behaviour; for example, policyholders reporting non-existent claims, or exaggerating existing claims, which would increase both frequency and severity.

Both of these increases are unpredictable and introduce additional uncertainty into the setting of future premiums.

Increased use of profit share arrangements

Profit share arrangements may incentivise the broker to pass on better quality business to the insurer. If the use of profit share arrangements increases and no adjustments are made to reflect this, this may reduce the expected profitability of the business being written.

2 Process uncertainty – effect on other areas of the business

Process uncertainty can also affect other areas of an insurer's business, besides claims. Some examples are discussed below:

2.1 Aggregators

During the last few years, a number of price comparison companies have been set up, dealing mainly with personal lines business. These companies find the best price for the customer from a pre-selected panel of insurers.

This has resulted in more transparency in pricing levels across the market, which could lead to more instances of anti-selection for under-priced segments of a portfolio.

Online price comparison sites are also called aggregators, or aggregator sites. Examples that operate in the UK include Compare the Market, Money Supermarket and Go Compare.

Insurers may have to pay a fee or satisfy certain conditions to be a member of this panel, which can have an uncertain effect on expenses.

There may also be different commission arrangements to those of a traditional broker, for example, a per policy charge as opposed to a percentage of written premium.

2.2 Off-shoring

During the last few years, there has been a trend for insurers to relocate some of their back office functions to different countries to access a cheaper labour market.

Back office functions include functions such as IT support and policy administration. In recent years, India has been a popular place to off-shore functions to.

Question

Suggest a reason for this.

Solution

India has a large pool of English-speaking people, who are technically proficient. It also met the criterion of 'cheaper labour market'.

Such a move is likely to have high set-up and redundancy costs.

The insurer also faces the uncertainty of currency fluctuations, assuming the off-shoring agreements are arranged in the off-shore currency.

2.3 The effect of economic conditions on investments and expenses

The general economic cycle is difficult to predict and has a significant effect on investment markets, most notably on investment returns.

3 Parameter uncertainty

Parameter uncertainty refers to the uncertainty arising from the estimation of parameters used in a model. Given that any model is an artificial representation of a real life situation and parameters have to be estimated from inherently variable data, there will always be a certain degree of parameter uncertainty in pricing models.

One of the requirements of a good model is that the parameter values used should be accurate for the classes of business being modelled. However this is easier said than done. Indeed, there might be several possible selections for a parameter, each appearing to be equally reasonable, yet a judgement has to be made as to which to select.

Other requirements of a good model are discussed in Subject SP7.

In this section, we discuss a number of sources which come under a broad heading of parameter uncertainty. Note: this is not intended to be an exhaustive list and other sources of parameter uncertainty exist.

3.1 Uncertainty arising from the data used

Data may be:

- of a poor quality
- internally inconsistent
- incomplete
- non-existent.

Poor quality data

There will be occasions where the raw data is poor; for example, claim / policy details may be inaccurate, with perhaps claim dates recorded as being prior to policy inception.

Inconsistent data

Data may also have inconsistencies, for example, changes in claim recording procedures.

Incomplete and non-existent data

In some instances, data may be incomplete or even non-existent, for example, when a new class of business is being written.

Insurers may also write business in new territories where they have relatively little experience. This will lead to uncertainty in setting prices.

Question

Suggest other reasons why data might be non-existent.

Solution

Data might also be non-existent for:

- new unusual risks
- business that is not new, but has changed its terms and conditions to such an extent that past data cannot be used.

Uncertainty at extreme values

An insurer may lack adequate data in the tail of the claim size distribution, *ie* for very large losses.

When fitting a particular distribution to a set of data, it is usually very difficult to fit the tails of the distribution. This may be because there is no data at these extreme values, or the data that exists is too volatile to be usable. Assumptions will therefore have to be made from what is available. This will give rise to uncertainty in the model output. Care should be taken when interpreting the model's output.

Certain events have little / no data

Certain claim events have insufficient data to build a reliable pricing model, or historical data may be deemed to be inappropriate.

Note the increasing use of the term ENID (events not in data).

Global weather patterns may be changing at such a pace that renders historical weather data obsolete.

On all of these occasions, assumptions will have to be made. These may be based on similar classes of business, benchmark statistics or the modeller's subjective judgement. In any case, inadequate data will lead to uncertainty within the model.

Format of data

Claims data can be stored in a number of different ways; for example, gross or net of reinsurance, or inclusive or exclusive of claims handling costs. It is important to have an understanding of exactly what is and what is not included in the data.

If there is any change in data storage protocols in the historical data, it should be considered whether adjustments will have to be made, since this may have an effect on the claims development pattern.

The example below shows how several of the problems described in this section can arise.

Example: Inadequate data supplied by third party claims handlers

There may be occasions when an insurer outsources its claims handling function, either to a broker or a specialist claims handling firm. On these occasions, data recording will be out of the hands of the insurer, and there may be some difficulty in checking data validity.

If different claims handlers are employed for different classes / sources of business, the way in which data is recorded may be inconsistent.

There may also be delays in passing the data to the insurer and these delays may also differ between claims handlers.

This will make it difficult to establish claims development patterns.

Question

Suggest how using data from third party claims handlers could create pricing problems.

Solution

Claim frequency

Third parties may not inform the insurer of claims until some time after the claim has occurred. This means that the insurer's claim frequency data will not be up to date, which could make the insurer slower to spot trends or changes in claim frequency relevant for pricing.

Claim amount

If an insurer switches to a third party claims handler, the third party may not spend as long validating claims as the insurer did. For example, they may accept claim amounts submitted by the insured, without checking for reasonableness / getting several estimates of the claim size. This could lead to higher ultimate claims, meaning that past data on claim severity may no longer be a good guide to the future.

Claim delays

There are likely to be delays in passing claims information to the insurance company. These delays are likely to vary between different claims handlers. This means the development patterns used for pricing will be more out of date and less reliable.

3.2 Change in case estimate reserving philosophy

The **reserving philosophy within a company will change from time to time.**

For example, if claims handlers have under-reserved a case in the recent past, they may be inclined to overestimate future claims to compensate.

There may also be changes in reserving philosophy following a change in senior personnel.

This could involve a change in reserving methods, or a change in the basis used for the reserve estimates (within an acceptable range).

If changes in reserving philosophy are known, it may be possible to make adjustments when setting future premium rates.

3.3 Large and exceptional claims

Large claims

Large claims can be expected to have different frequency and severity distributions to attritional and catastrophe claims.

There will be additional uncertainty when setting large claims provisions within pricing models

On some occasions, there may be an absence of large reported claims, and the pricing actuary may wish to add a loading to reflect this fact. This will give rise to additional uncertainty.

Catastrophes

Catastrophic losses can take the form of one immense loss, such as an oil-rig explosion. Alternatively, there may be many smaller insured losses, all stemming from a common, identifiable event such as a hurricane.

Catastrophes are typically hard to predict, so are hard to allow for when pricing. Catastrophe modelling is discussed later in the course.

One way to reduce the impact of catastrophic losses is to write business in a wide range of geographical locations and across many classes. Catastrophe reinsurance will also help (more of this later in the course).

Latent claims

Claims can result from sources that were unknown, or for which a legal liability was not expected, at the time of writing the business. The expected cost of such claims cannot be calculated with any accuracy for the purpose of setting premiums.

The first problem with latent claims is that it is impossible to know where the potential claim is lurking. Secondly, if the claim does materialise, the future claim cost is very uncertain.

3.4 Claims inflation not as expected

Inflation assumptions will be required when setting premiums for future periods of insurance.

The actual inflationary experience could be a significant determinant of price adequacy.

3.5 New distribution channels

The expenses for new distribution channels, including the set-up costs, will be far less certain than those for existing channels.

More generally, different distribution channels will have different expense profiles.

Question

Comment on whether the main expenses are fixed or variable for:

- broker sales
- internet sales.

Solution

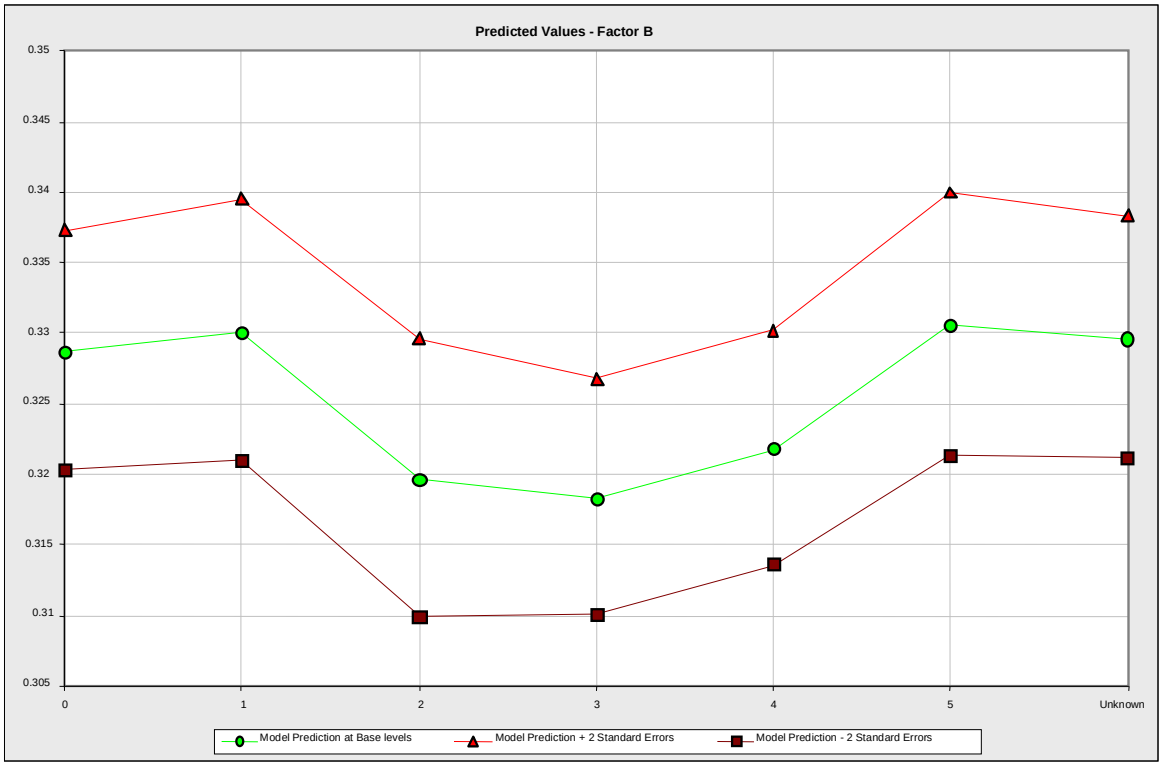
Broker sales may have a high variable cost and a low fixed (setup) cost.

This is because commission is incurred every time a policy is sold.

Internet sales may have a high fixed cost, *ie* setting up and testing the website**,** and very little variable cost.

Commissions paid to brokers and other intermediaries are usually expressed as a percentage of the premiums payable, so can be fairly straightforward to estimate for business planning purposes, based on expected business volumes. Other expenses are less straightforward to estimate, giving rise to greater uncertainty, *eg* underwriting costs will depend on the level of, and time spent on, underwriting.

However, if the mix of sales differs from what was expected (either by class, distribution channel or broker), so that a higher proportion of business is sold on higher commission terms, the average commission rate will increase. Hence, uncertainty over the future mix of sales can give rise to added uncertainty when estimating future commission payments.



Comparisons over time

To test the consistency of parameter estimates over time, we can fit a model that includes the interaction of a single factor with a measure of time, *eg* a calendar year.

Recall from Section 2.2 that an interaction exists when the effect of one factor varies depending on the levels of another factor. In the case of time interactions, we are testing whether the effect of our factor varies depending on the year (or other specified time period) of the experience.

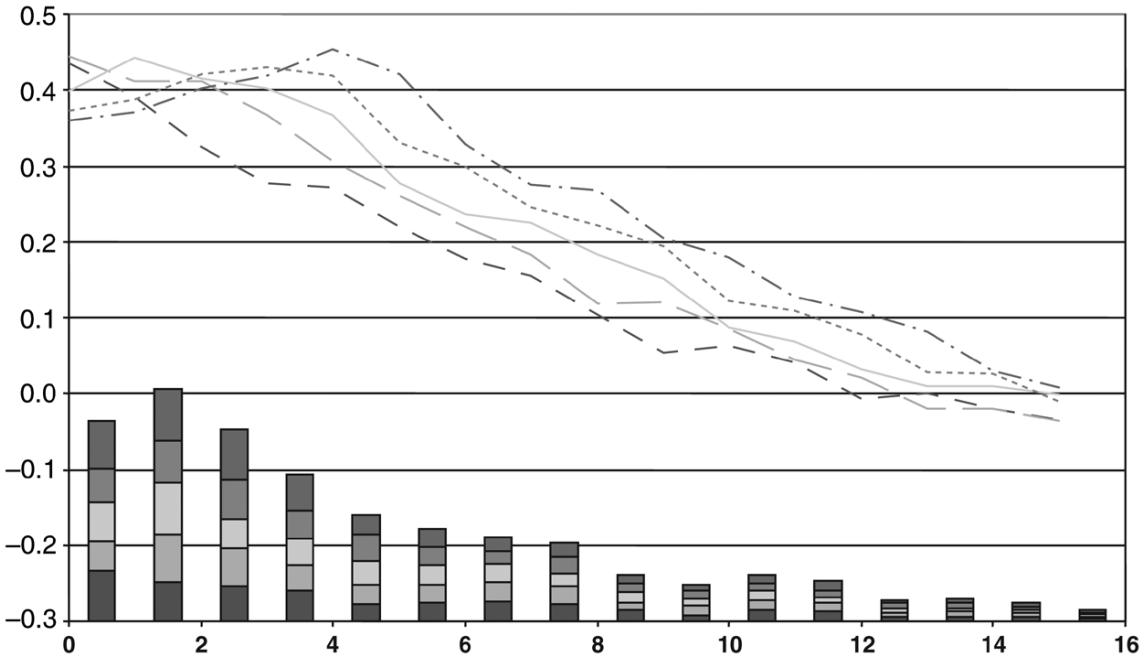
The time consistency check (derived by interacting each factor in turn with a time-related factor) is important for pricing work, because typically you will be analysing data from two to seven years ago, and then deploying rates for the next year. So if the pattern you select is moving rapidly over time, then the model average selected will be inappropriate for future periods.

The time consistency check is also used to determine more generally whether the effect of each factor is consistent from year to year. If it is consistent then it is likely to be a good predictor of future experience.

Let us consider two examples.

Example 1

The first example **is where there is a time consistency problem.**



This shape was generated on a car theft frequency chart a few years ago, during the period when motor manufacturers were rapidly improving their security measures. In this chart

- **the *x*-axis is vehicle age**
- **the lines are the parameter estimates for each year (newest is '– · – · – ·', oldest is '– – – –')**
- **the bars are the exposure by year.**

The exposure bars on the graph represent the amount of data at each level of vehicle age in each year, *ie* a different shade is used for each year.

This rendered newer vehicles untouchable for a while, so thieves started to target older, less secure vehicles. Hence the responses appeared to translate year by year to the right.

In the graph above, the pattern of parameter estimates is translating year by year to the right.

New cars are the most valuable to thieves but, with improvements in security measures over time, they are becoming more difficult to steal or break into. Therefore, the highest theft frequencies in any year are likely to relate to the newest cohort of cars that don't have high levels of security. Each year this cohort gets older by one year, *ie* vehicles that were new in Year n would be one year old in Year $n+1$. In terms of the graph above, we can see that the level of vehicle age with the highest parameter estimate (and hence highest expected claim frequency) is increasing year on year and this is why the lines on the graph appear to be shifting to the right.

Question

Explain why we would not expect the theft claim frequency for all new cars to be zero for the more recent years, despite the improvements in manufacturer security features.

Solution

Some manufacturers will introduce higher levels of security than others and at different times. An individual manufacturer may also introduce different levels of security depending on the model of the vehicle.

Claim frequencies can relate to theft *of* vehicles but also to theft *from* vehicles. The security improvements, *eg* immobilisers, are likely to have a greater effect on 'theft of' but will not necessarily stop 'theft from'.

New cars are still usually the most valuable in the eyes of thieves and over time they will find new ways of getting around the security features, *eg* keyless technology has been targeted by thieves in recent years.

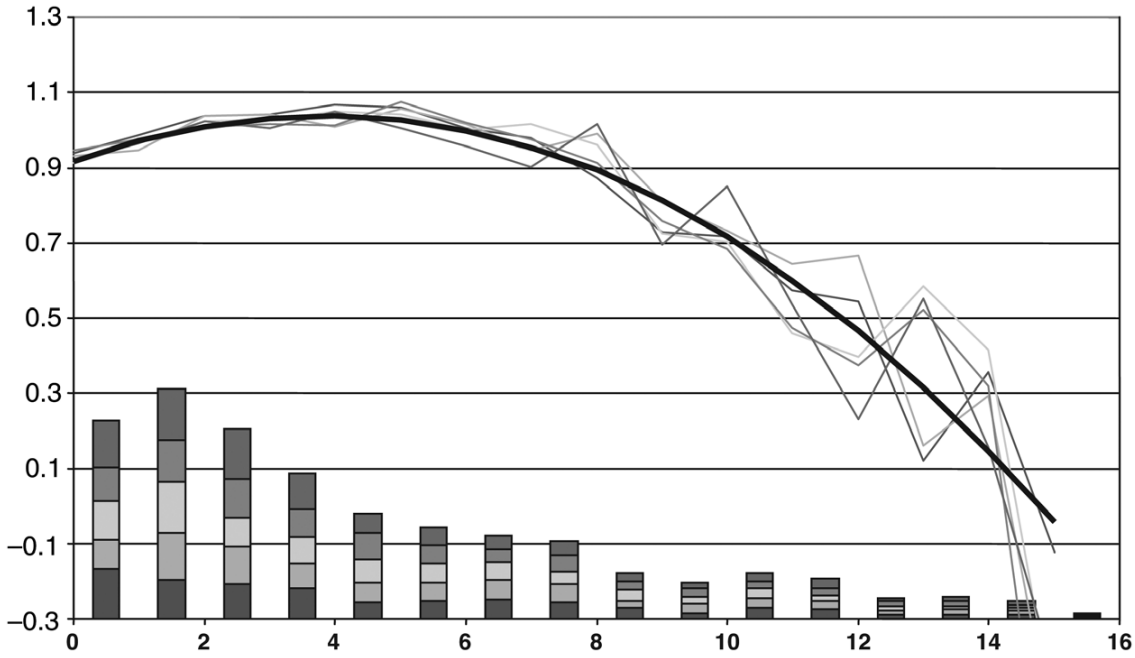
Some policyholders may not make use of the security measures on their vehicles, making these more susceptible to theft. Even if it is a condition of the insurance to use these, a claim is still likely to be paid if the insurer can't prove that the policyholder has been negligent.

In this case the relativities that would be suitable to deploy for a future year should be something like the response for the latest year, translated by the projection period, and with an ad-hoc adjustment for how the modeller thinks this change may develop.

Example 2

The second example (on the next page) is more usual. We see the model fit line (thick bold curve) varying smoothly across the factor, and the time consistency responses varying randomly around this average. The amount of variation should decrease with larger exposure.

This is another example showing the effect of vehicle age (along the *x*-axis) although in this case it is more likely to relate to damage frequencies rather than theft frequencies. We can see that the parameter estimates for the lower car ages are based on more exposure data than the higher car ages and therefore show less variation in the estimates.



Consistency checks with other factors

Note: time is not the only factor that can be used as a consistency check.

If you are producing a model for a multi-distribution channel business then it is particularly important that each factor is checked to ensure that it is valid for every channel.

For example, a factor such as the age of the vehicle would be expected to show the same pattern regardless of the distribution channel used. Fitting a model that includes an interaction between age of vehicle and distribution channel, and plotting a graph of the results, would highlight any distribution channels where the effect of age of vehicle was different from the others. If this is the case then you would need to do further investigations.

Differences in the data collection methods by channel can cause problems here.

Also a random factor could be created in the data, as a means to check consistency for a factor.

Each observation in the data could be randomly allocated to one of ten (say) groups, the idea being that each group is then a representative sample of the total data. Each of the ten randomly allocated groups would be expected to behave in a similar way to each of the other groups and to the whole data.

A new factor would be created, with ten different levels, representing the random group that each observation had been allocated to. Let's call this new factor *randomgroup.*

So if we wanted to test whether age of policyholder (for example) was showing a consistent pattern throughout the whole data, we could fit a model to the whole data that included an interaction term between policyholder age and randomgroup.

If this interaction term is insignificant in the model then we would conclude that the effect of policyholder age is the same for every level of randomgroup and that policyholder age is consistent throughout the whole data.

There are different forms of indexation clause depending on where the contract was placed. There is a standard clause in the London Market (LMIC94) and this in effect indexes the limit and retention in line with average earnings up to the time the claim is settled. The earnings index to use is specified in the clause (for example, in the UK it is a particular index produced by the National Statistics Office; for other countries it is the index produced by the IMF, *ie* International Monetary Fund**).**

For contracts placed outside London, the reinsurer should read any indexation clause carefully to understand how it works. For example, many European clauses index each individual payment for a claim separately to its payment date and then apply the overall weighted average indexation for the sum of the payments under the claim to determine the indexed limit and retention.

In addition to all this, indexation clauses come in three variants:

- **Fully indexed – index the limits and retentions for the full effect of inflation between the contract commencement date and claim settlement date (London clause) or loss date and payment date(s) (European clauses). That is, the product of the published applicable earnings inflation rates is calculated for the period required.**
- **Severe indexation – calculate the effect of indexation as above, but only apply it if the cumulative indexation increase is above a particular threshold (for example, 25%) and then only index for the excess of indexation over the threshold. So, if the cumulative indexation factor is 1.275 and the threshold was 25%, multiply the limit and retention by 1.02 (1.275/1.25) in effect.**
- **Franchise indexation clause – calculate the effect of the index as above, but only apply if the cumulative indexation is above a particular threshold. Once it exceeds the threshold apply the full cumulative indexation. So in the previous example we would multiply the limit and retention by the full 1.275.**

You may come across other types of indexation clause in your work.

The reinsurer can allow exactly for indexation in a burning cost calculation, but this can become very complex where multiple countries (so indices) and payment date indexation are involved.

The reinsurer can make a simpler, if approximate, allowance by estimating the average delay to settlement / payment (whichever is appropriate). By making an assumption about the average future rate of earnings inflation (which may be a weighted average if more than one country is covered) the average effect of indexation can be calculated. This can be used to calculate to what on average the limit and retention should be indexed, and thus to price a layer with this limit and retention.

The reinsurer can do this just for injury claims and price the non-injury claims, where there are any, separately. Or the reinsurer can estimate the proportion of the claims that the reinsurer believes will be injury and can use this to weight between the unindexed and indexed layer prices.

6.4 Swing rates

Sometimes – often in situations where there is a marked difference in opinion about the future loss experience between reinsurer and cedant – a contract may be swing rated. This means the final rate (premium) paid will depend on the loss experience very directly.

Question

State what swing rating is a form of.

Solution

Swing rating is a form of experience rating, as the premium paid depends on the loss experience in the period of cover.

There are two forms of swing rate:

- **In the first version, sometimes called 'minimum plus', the final premium that the cedant pays consists of a minimum (paid upfront) plus a factor times the actual losses to the layer, subject to an overall maximum amount.**

  In practice, the amount paid upfront is often a provisional amount between the minimum and maximum, rather than simply being the minimum. This is illustrated in the example below.

- **In the second version, the cedant pays an upfront premium and then the final premium is determined as a factor times the losses subject to a minimum and maximum. Usually the deposit is between the minimum and maximum.**

The factors may be different depending on the chosen form. The cedant might end up with a refund of some premium.

Common factors for the second version are 100/80 or 100/75. For the first version, the factors tend to be more variable, as they depend more on the minimum, but still tend to be greater than one.

Example – First Version (Minimum-plus)

The minimum rate is assumed to be 4% of gross subject premium income (GP) with a 10% provisional rate and an 18% maximum rate. The loss load is assumed to be 110%.

The 'loss load' is the factor we apply to the aggregate recoveries in the formula (below) to calculate the final premium.

The premium paid initially is based on the provisional rate, but as losses develop the premium is adjusted to:

$$\text{Swing Rate} = \text{minimum of} \left\{ \text{maximum rate}, \left[\text{minimum rate} + (\text{recoveries x loss load}) \right] \right\}$$

$$= \text{minimum of} \left\{ 18\% \text{ of GP}, \; 4\% + (110\% \text{ x aggregate recoveries}) \right\}$$

The initial premium paid in this example is 10% of the gross subject premium income (GP), *ie* 10% of the cedant's premium for business covered by the contract. This is then adjusted (up or down) according to the formula above, depending on the aggregate recoveries experienced.

Note: the terms of the slip will determine when the adjustments are made.

Example – Second Version

The provisional rate is assumed to be 10% of gross subject premium income (GP) with a 4% minimum and a maximum of 20%. The swing is 120% of recoveries.

The 'swing' here refers to the factor applied to the losses to the layer in order to calculate the final premium to charge the cedant.

Initially the provisional premium is paid which is then adjusted at stated intervals until all losses are settled. Again, the slip will determine when the adjustments are made. For long-tail lines of business there will sometimes be allowances for IBNR / IBNER losses until all losses have been settled.

If the gross subject premium is £10*m* and the losses are initially estimated at £1*m* (after one year) but ultimately settle (after three years) at £1.5*m* then the cashflows will be:

$$\text{Provisional Premium} = \text{Gross Subject Premium Income x Provisional Rate}$$

$$= \text{£10m x 10\%} = \text{£1m}$$

$$\text{Initial adjustment (Year 1)} = \text{Estimated Loss x swing}$$

$$= \text{£1m x 120\%} = \text{£1.2m}$$

An additional £0.2*m* of premium is payable at this point.

$$\text{Final adjustment (Year 3)} = \text{(Estimated) Loss x swing}$$

$$= \text{£1.5m x 120\%} = \text{£1.8m}$$

A further £0.6*m* of premium is payable. A check is also made to ensure the final premium does not exceed the maximum rate.

The fundamental difference between the final premium calculations for these two types of contract is that, with minimum-plus, the basic quantity calculated (before applying the maximum and minimum) is:

(% of GP) + (Aggregate recoveries $\times$ Factor)

whereas, in the second version, the basic quantity calculated (before applying the maximum and minimum) is simply:

(Aggregate recoveries $\times$ Factor) .

Question

Explain why insurers would want this reinsurance, assuming the factors used are greater than 1.

Solution

If the cedant's experience is worse than expected (by a sufficient degree), the maximum will apply thus capping their losses.

Otherwise, the cedant will pay a bit more in premium than they would have paid in claims had they not reinsured, but they accept this as the price of removing some of the downside risk.

To price a swing-rated contract, the approach is rather similar to that for proportional contracts:

- **Start with an estimate of the aggregate loss distribution.**
- **Check the terms of the swing (and again the cedant and/or their broker may suggest terms to start with) to see if they meet the required profit criteria.**
- **If not, the reinsurer can vary the terms to find combinations that do.**
- **The reinsurer then has to negotiate the terms.**

The reason these contracts work in situations where there is a disagreement about the expected loss experience is that if the reinsurer turns out to be right, the swing will ensure more premium is collected, and if the cedant turns out to be right, the swing ensures less premium is collected. In both cases, the actual losses determine the outturn (outcome).

6.5 Loss ratio caps

These commonly appear in conjunction with swing rating. The reinsurer applies a maximum limit on cover which prevents the loss ratio to the contract exceeding a certain limit. Caps of 250% and 300% are common.

These are awkward to price as the amount of limit depends on the price, *ie* the value that is being determined.

This can be done iteratively.

- **Set the price without a limit.**
- **Work out what amount of limit corresponds to the loss ratio using the unlimited price.**
- **Reset the price with that maximum limit.**
- **Repeat until the premium stabilises.**

It is worth checking from the aggregate loss distribution what the likelihood of the cap being breached on an unlimited price basis would be first. If it is very low, then it is probably not unreasonable to assume the unlimited price.

7 Tables of data items

The table below outlines the typical data requirements for three types of reinsurance:

Property (re)insurance	*Casualty*	*Marine*
Insured name	**Insured name**	**Insured name**
Policy inception date	**Policy inception date**	**Policy inception date**
Policy expiry date	**Policy expiry date**	**Policy expiry date**
Programme identifier ('stacking code')	**Programme identifier ('stacking code')**	**Programme identifier ('stacking code')**
Property identifier	**Line of business (*eg* public liability and employers' liability)**	**Line of business (*eg* hull, cargo, specie and P&I)**
Postal code/zip code/cresta zone	**Insured industry type/code**	**Insured flag (for hull, Protection & indemnity (P&I))**
Property TIV (total insured value)	**Limit**	**Limit**
Premium charged for property	**Deductible/excess**	**Deductible/excess**
Occupancy type	**Premium**	**Premium**
Insured activity (commercial property)	**Original brokerage/commission**	**Original brokerage/commission**
Buildings sum insured	**Cost of any fac/ri purchased**	**Cost of any fac/ri purchased**
Original brokerage/commission	**Limit of any fac/ri purchased**	**Limit of any fac/ri purchased**
Cost of any fac/ri purchased	**Deductible/excess for any fac/ri purchased**	**Deductible/excess for any fac/ri purchased**
Limit of any fac/ri purchased	**Cedant's line on the insured risk**	**Cedant's line on the insured risk**
Deductible/excess for any fac/ri purchased		
Cedant's line on the insured risk		

The programme identifier (often also referred to as the 'stacking code' or 'link code') should enable the reinsurer to identify individual policies that are all part of a programme of layers of insurance for a particular insured that stack one on top of another and all cover the same perils / risks / events. This is important because for this insured the cedant is exposed to a single claim equal to the sum of the limits the cedant writes on these stacking layers. It increases the maximum loss size that is possible. This is also important for recovering outward reinsurance.