INSTITUTE AND FACULTY OF ACTUARIES

EXAMINERS' REPORT

April 2012 examinations

Subject ST8 – General Insurance: Pricing Specialist Technical

Purpose of Examiners' Reports

The Examiners' Report is written by the Principal Examiner with the aim of helping candidates, both those who are sitting the examination for the first time and who are using past papers as a revision aid, and also those who have previously failed the subject. The Examiners are charged by Council with examining the published syllabus. Although Examiners have access to the Core Reading, which is designed to interpret the syllabus, the Examiners are not required to examine the content of Core Reading. Notwithstanding that, the questions set, and the following comments, will generally be based on Core Reading.

For numerical questions the Examiners' preferred approach to the solution is reproduced in this report. Other valid approaches are always given appropriate credit; where there is a commonly used alternative approach, this is also noted in the report. For essay-style questions, and particularly the open-ended questions in the later subjects, this report contains all the points for which the Examiners awarded marks. This is much more than a model solution – it would be impossible to write down all the points in the report in the time allowed for the question.

T J Birse
Chairman of the Board of Examiners

July 2012

General comments on Subject ST8

Subject ST8 deals with applications of general insurance pricing techniques across many different types of product. Candidates should expect the examiners to draw these applications from all parts of the syllabus in order to test as wide as possible a range of skills and, in particular, to achieve a fair balance between personal and commercial lines.

Examiners will sometimes require the use of standard general insurance and statistical techniques that are covered in earlier subjects. Candidates should ensure that they are familiar with these when preparing for the ST8 examination.

As well as pricing techniques, ST8 also covers the workings and use of reinsurance products, so candidates should also expect the examiners to set questions on these aspects.

In questions with an element of calculation, different numerical answers may be obtained from those shown in these solutions depending on whether figures obtained from tables or from calculators are used in the calculations. Candidates are not penalised for this. However, candidates may be penalised where excessive rounding has been used or where insufficient working is shown. Where questions require looking up values in tables, candidates are expected to interpolate between two values if reasonable to do so, even when this is not stated in the question.

Where examples are given in the solution to illustrate the points made, marks were awarded to candidates who gave these particular examples or an equally valid alternative.

Comments on the April 2012 paper

The level of difficulty of the paper and the general performance of candidates were very similar to recent sittings. A number of well-prepared candidates scored strongly and displayed a good understanding of the subject across the whole paper. There was some evidence of time pressure amongst candidates around the pass-mark area, but this certainly did not appear excessive. Failure to show workings in numerical and algebraic answers was a recurrent theme in this sitting. Candidates should note that the examiners cannot award any marks where the final answer is incorrect and workings are missing or unclear. However, marks can be awarded for partially correct workings where these are shown clearly.

Q3 contained an error in a mathematical formula on the paper, making it impossible for candidates to prove the result. This error only affected the final stages of the proof, worth one mark, and it was interesting to note that many candidates did not get anywhere near the point where the error would have caused them a problem. The approach taken to compensate for the error was to scale up any marks credited for the remainder of the solution, so that candidates could still obtain full marks for the question.

Nearly all of the questions produced a good range of scores, but Q4 and Q7 had a lower range than the remainder. The very last part of Q8 was designed to stretch the better candidates, but in fact this was very poorly attempted overall.

The comments that follow the questions concentrate on areas where candidates could have improved their performance. Candidates approaching the subject for the first time are advised to concentrate their revision in these areas.

1 (i) (a) Aims:
to transfer reserve development risk
i.e. to cover the volatility arising from past activities.

(b)

- when reinsuring to close a Lloyd's syndicate year of account
- when winding up a company
- corporate restructuring (or change in strategy)
- capital restructuring (or to free up capital for new business)
- mergers and acquisitions
- closing lines of business (leading to loss of expertise)
- where a reinsurer can run off the business more cheaply
- economic changes in the value of the liability
- regulatory, accounting or tax changes
- legal developments
- for example, court decisions

This bookwork part was generally answered well. Better candidates drew out the distinctions between run-off reinsurance and other types; poorer answers could have been applied to any type of reinsurance.

(ii) **Adverse Development Cover**

In return for a premium, the reinsurer agrees to cover the ultimate settled amount of a specified block of business above a certain pre-agreed limit.

This may be greater than the current level of reserves.
The premium payable will depend on the risk appetite of the market.
There could be an upper limit too i.e. the insurer is still liable for the excess.
The reinsurer may also insist that the insurer has a small participation in the layer
Claims are still handled by the insurer.
Reserves are maintained by the insurer.
So the insurer still bears the associated expenses and receives investment income relating to the claims and reserves.
The insurer remains legally liable to the insured parties and is exposed to the credit risk of the reinsurer.

Loss Portfolio Transfers

The whole liability for the book of business is passed from the current insurer to the new insurer, so the new insurer is totally responsible for the liabilities from the date of transfer.
Therefore, an LPT is not strictly reinsurance.
Policyholders will be informed of the transfer.
The transfer may need court approval.
The reserves are transferred ,along with the remaining exposure plus, possibly, an extra premium.
The new insurer receives the future investment income and claims risks.

The new insurer would normally handle the future claims.

Many candidates made a good attempt at this part. The main reason for losing marks was simply not writing enough points. However, there were also common misunderstandings. Many candidates were unclear how each type of reinsurance was financed, i.e. a premium is payable for ADC, whereas LPT primarily involves the transfer of reserves. Confusion often appeared over the loose use of terms "reserves", "assets", "investments" and "liabilities", which conveyed a lack of understanding. Several candidates contradicted themselves by implying that they were considering ordinary reinsurance, such as referring to future premium income.

2 The most important consideration is the degree of fit to the expected future experience.

Degree of fit can be tested using formal statistical tests in the modelling process.
e.g. Akaike Information Criterion, or other valid test (not chi-square, as models are not nested)

There might be a rapid trend over time towards either A or B.
A time consistency check involves interacting the district with a time-related factor and looking for a trend.
Another check is to subdivide by a random factor.
The degree of uncertainty of the model parameters can be assessed by calculating standard errors of the parameter estimators.
The spread of relativity values across districts can be combined with their standard errors to check that their error ranges do not overlap too much.

Over-fitting is a danger because this causes the model to lose predictive power.
A check on this is to withhold some data from the sample used to fit the model and perform tests on the model's fit to the withheld data (or use an out-of-time dataset).
Cook's distance can be used to see whether any data points have an undue influence over the choice of A or B.
e.g. young drivers in urban areas, or a large liability claim.

Model A's graph is steeper than B's, so A differentiates more between good and poor experience for this factor.
However, more discrimination between risks is only helpful if the fit is also better.

A lift curve could be constructed to compare the predictive power of A and B on an out-of-sample dataset.
One method is to rank all out-of-sample data by expected burning cost for each model separately, then plot a graph of actual experience against each of those rankings on the same chart, using the same exposure scale. The steeper the curve, the more effective the model is at distinguishing high from low burning cost.

A gains curve can also give information on the value added by the district classification.
With this method the data is sorted high to low according to the fitted model values and a graph can be plotted to show the cumulative values of the fitted model and the

observed values from the data against cumulative exposure. This could be done for each of A and B.

The Gini coefficient can then be calculated to provide a statistical measure for the lift produced by the model. This can be thought of as the area enclosed by the model curve and the diagonal line as a ratio of the triangle above the diagonal.

Curve A is not as smooth as curve B, so we may wish to smooth/adjust it before using it.
We should beware of smoothing too much, as this will reduce fit.

Curve A slopes the wrong way for districts 4 to 6, so this may need to be looked into further and adjusted for.

We would need to consider the market's approach to this factor, i.e. do some market comparisons for various postcodes, because we might not want to be too far out-of-line for policies in our target market and/or we may not need to be as cheap for postcodes in the low districts.

Consider how our mix of business might change in the future depending on which of the two district allocations we choose.

We would also need to consider the extent of the change from the existing district structure, e.g. by plotting it on the same graph, for comparison, and particularly the impact on customer price, e.g. identify where large swings in prices are expected.

How practical is it to implement either structure (ie, is one more complicated than the other)?
Will either structure result in large jumps in premium for a small change in distance (risking customer dissatisfaction)?
Does the choice of A or B make a significant difference to the overall model?

Some candidates made a very good attempt at this question by looking at a wide range of ideas, including the fit with the existing structure and impact on competitive position. However, many candidates appeared not to understand the aim of the question and did not generate sufficient relevant points. The following were common errors:

- *Discussing how to carry out GLM analysis or types of spatial smoothing in order to derive district allocations, even though the question states that these allocations had already been prepared.*

- *Assuming that the steeper relativity curve (A) must be a better fit to the data because it discriminates more between rating areas.*

- *Stating that the amount of exposure in each point should be examined, even though the question states that this is not necessary.*
- *Writing at length on theory of GLMs and failing to consider the actual curves in the question.*

- *Writing at length about spatial smoothing.*

3 From the Tables (p17): For an integer-valued distribution, an underlying assumption of Panjer's formula is that there are numbers a and b such that:

$p_r = (a + b/r)\, p_{r-1}$ for $r = 1, 2, 3, \ldots$.

From the Tables (p6), for the binomial distribution,

$$p_r = \binom{n}{r} p^r q^{n-r} \qquad \text{for } r = 0, 1, 2, \ldots n$$

so

$$\frac{p_r}{p_{r-1}} = \frac{\binom{n}{r} p^r q^{n-r}}{\binom{n}{r-1} p^{r-1} q^{n-r+1}}$$

$$= \frac{n!}{r!(n-r)!} \cdot \frac{(r-1)!(n-r+1)!}{n!} \cdot pq^{-1}$$

$$= \frac{(r-1)!}{r!} \cdot \frac{(n-r+1)!}{(n-r)!} \cdot \frac{p}{q}$$

$$= \frac{(n-r+1)}{r} \frac{p}{q}$$

$$= \frac{(n+1)}{r} \frac{p}{q} - \frac{p}{q}$$

Setting

$$a + \frac{b}{r} = \frac{(n+1)}{r} \frac{p}{q} - \frac{p}{q}$$

gives

$$a = \frac{-p}{q}$$

and

$$b = \frac{(n+1)p}{q} \quad \text{or} \quad \frac{(n+1)p}{(1-p)} \text{ where } q = 1 - p$$

Substituting into Panjer's formula gives:

$$g_r = \Sigma_{x=1}^{r}\left[\frac{-p}{(1-p)} + \frac{(n+1)px}{(1-p)r} f_x g_{r-x}\right] \text{ for } r = 1, 2, 3, \ldots$$

$$= \Sigma_{x=1}^{r} \frac{p[(n+1)xr^{-1} - 1]}{(1-p)} f_x g_{r-x} \quad \text{for } r = 1, 2, 3, \ldots$$

as required.

Note that the above formula appeared incorrectly in the question paper.

g_0 can occur if and only if $N = 0$
i.e., if $P(N = 0) = p_0$

$$= \binom{n}{0} p^0 q^n$$

$$= q^n$$

as required.

Some students omitted this question altogether, or made no serious attempt at it. Those who did attempt it generally did quite well, with a high proportion getting full marks. Most candidates were at least able to show that $g_0 = q^n$. Poorer candidates threw away marks by making trivial arithmetical mistakes, compounded by showing little working, making it difficult for examiners to give any credit for interim steps.

4 (i)

- It is helpful to be aware of competitive position because it helps to estimate impact of price changes on volumes and income.
- The method could work well if the product has few rating factors.
- Tracking the market may be useful if some of the individual products have only small volume, or history is unavailable (e.g. book was purchased or taken over), or if the basket of risks includes new areas of risk.
- However, this "large" book should have good enough volume of data for using own experience.
- Failure to use the company's own experience may result in a higher capital requirement, or a higher reinsurance cost.
- There could still be enough scope for variation between the company's prices and the competitor's, even if the average is similar.
- Or it might not be tight enough to attract enough customers if the class of business is very competitive.
- It might be better to use more than one competitor to avoid large price swings.

- The constraint on pricing strategy could erode profitability overall (ie be sub-optimal) in the following ways:
  - Writing some risks at unprofitable rates.
  - Losing business by charging too much for some risks.
- The price comparison may be distorted/invalidated by:
  - Product features and benefits not being identical.
  - Periods of time in which the competitor is running a special promotion.
  - Insufficient volumes in the basket of risks.
  - A small number of very high prices skewing the average.
  - Differences between insurers, such as expense base, reinsurance structure.
  - Strategy of the competitor, such as loss leaders or desire for growth.
- If open-market prices are readily available then it could be a quick and easy method of setting a price.
  - However, it could be time-consuming and expensive because telephone and face-to-face channels must be worked manually, and internet sites may have anti-screen-scraping measures.
- Some prices may not be visible at all, for example negotiated discounts, affinity or loyalty discounts.
- If the company wants to apply the approach for renewals as well as new business, reliable renewal prices will be almost impossible to obtain.
- There may be legal issues with obtaining the data, such as legislation on accessing websites, mystery shopping or competition law.
- Prices could become out-of date very quickly.
- If the two insurers represent a large share of the market, this practice could amplify the insurance cycle.
- The practice could become known to the public, which could erode consumers' confidence in the industry or give rise to an investigation by the authorities.

(ii)

- What are the objectives and perceived problems that have led to the % constraint?
- How was the 5% figure arrived at (or why do they think that 5% is the right number)?
- Is the class of business profitable for the competitor at current prices?
- How was the competitor chosen?
  - E.g., are they a market leader in pricing capability?
- What will happen if the competitor changes its market position radically (e.g. exits a line of business)?
- How will the basket of risks be defined?
  - which classes of business;
  - which channels (telephone, internet, face-to-face);
  - extent of coverage (footprint), e.g., excluding unusual risks;
  - what volume of risks;
  - what combinations of cover options;
  - how often will the definition (not the prices) be refreshed.
- How frequently will the comparison be made?
- How will the average price be calculated?

- just one average price or broken down by channels and cover types;
- how should missing prices be treated;
- how often will the competitor price data be collected;
- what weightings will be used.

Candidates generally answered this question poorly, either because of the way they interpreted the question or because they did not generate enough ideas.

Some candidates appeared to interpret the use of the word "merits" in this question to assume examiners were only looking for positive aspects of this approach. A surprising number of candidates appeared to assume that the price for every individual risk would be set within 5% of the competitor's price, going on to claim that this would eliminate the risks of anti-selection.

Many candidates wasted time by talking about how the proposal makes the pricing process easier or quicker, simply repeating themselves by doing so, without thinking of valid reasons why it could be used (low volumes of past data etc). Many came up with spurious advantages (it would boost volumes, inspire customer loyalty etc). Few mentioned why it may be useful in terms of a new area of risk, lack of volume, lack of history etc. Fewer still thought of mentioning legal issues and the difficulties that may arise with obtaining competitor price information.

Part (ii) was often just a repeat of what was written in part (i). Examiners gave credit under Part (i) for distinct points made under Part (ii) and vice versa, but not where the same point was repeated.

5 (i) It is important to pick a curve that is most representative of the firm being priced
i.e., appropriate to the class of business and type of cover,
but still keep in mind that adjustments might be needed.
In practice, the choice will depend on which curves are available.

Factors to consider when selecting/adjusting:

- Whether the assumptions for the theory to hold are valid, i.e.:
  - ground up loss frequency is independent of limit purchased;
  - severity is independent of number of losses and limit purchased.
- The amount of experience we have of losses for the particular firm compared with the other data available (i.e. credibility considerations).
- Treatment of loss adjustment expenses:
  - allocated (ALAE);
  - unallocated (ULAE).
- Loading for volatility or "risk".
- Nature of limits to cover for this risk compared with the curve assumptions, e.g. per claimant/per occurrence.
- Whether the curve is appropriate to the jurisdiction or claims environment.
- Effects of trends in the claims environment and whether these are reflected in the curves.

- Effect of claims inflation and whether reflected in the curves.
- Particularly as a result of legal reform.
- How up-to-date the curve is.
- ILF absolute limit values may need to be adjusted for the period between derivation and prospective period of cover.
- Which curves are generally used in the market (if available).

This part was generally answered well by candidates who knew their bookwork. However, many made their points too briefly, e.g. just writing "inflation", which made it difficult to award any marks. A number of candidates wasted time by explaining what they would need to do in order to build an ILF curve from their own data, which was not required.

(ii) There are more larger claims in curve B than in curve A relative to smaller claims (ie fewer smaller claims).

This part was answered well by candidates who understood the mechanics of ILFs. However, many candidates failed to realise that the ILF curve can only show relative claim distributions. Concluding that B would give rise to more claims than A (since it takes a value of 3.5 at a $10m limit vs 2.5 for A) would be erroneous. Some just drew or described the curves given, rather than answer the question about what the shape of the curves inferred about the claims distributions.

(iii) Possible differences in:

- Risk management culture and governance practices in the firm.
- Skill and experience of the firm's employees.
- Domiciled territories of the firm (location of its registered office).
- Practising territories of the firm.
- Areas of practice of the firm (e.g. audit, tax etc).
- Types of client that the firm has (e.g. government).
- Size of firm (e.g. no. of staff or turnover).
- Extent and type of coverage of the insurance (e.g. punitive damages covered)
- Size of projects/contracts that the firm has with its clients.
- Indemnity limits applied in agreements between the firm and its clients.

This was an opportunity to demonstrate an understanding of what drives risks in the real world and was answered well by the majority of candidates.

(iv)

A

ILF ($.5m xs $1m)	0.5*1.35+0.5*1–1 0.17500
ILF ($2m xs $6m)	(0.6*2.5+0.4*2)–(0.2*2.5+0.8*2) 0.20000
ILF (Base to Policy)	0.2/0.175 1.14286
Policy loss cost	250*0.2/0.175 285.71429

B

ILF ($.5m xs $1m)	0.5*1.5+0.5*1–1 0.25000
ILF ($2m xs $6m)	(0.6*3.5+0.4*2.5)–(0.2*3.5+0.8*2.5) 0.40000
ILF (Base to Policy)	0.4/0.25 1.60000
Policy loss cost	250*0.4/0.25 400.00000

This part was generally answered well. Common mistakes included:

- *Calculating the two separate ILF curves correctly but then using an incorrect method to obtain the loss cost.*
- *Confusing $2m XS of $6m with $6m XS of $2m.*
- *Arithmetic slips with no intermediate working shown.*

6 (i)

- A group of Lloyd's Names
  who collectively co-insure risks.
- Names can be individual or corporate.
- Syndicates often focus on heavy commercial, reinsurance or specialist classes.
- Each syndicate appoints a managing agent to run its insurance operation.
- The syndicates employ underwriters to write insurance business on behalf of the members.

- Syndicates are authorised and governed by Lloyd's.
- Each member contributes capital to the syndicate.
  and accepts portions of the risk proportional to their capital.
- Profit and loss is shared amongst the members in these proportions.
- The member's share of a syndicate is fixed during an underwriting year, but may change from year to year.
- Lloyd's syndicates have access to Lloyd's global licences.
  enabling them to write business almost anywhere in the world.

Candidates generally scored well in this part, with most being able to generate plenty of points on the workings of Lloyd's syndicates. However, many went into detail regarding other aspects of Lloyd's, such as 3-year accounting, which was not required.

(ii) Calculating on-level gross premium

Year of Account	*Gross Premium*	*Ultimate Gross Premium*	*Rate Index*		*On-level Gross Premium*
2007	4,976	4,976	0.8978	0.9975*(1+–0.1)	4,468
2008	4,941	4,941	0.9975	1.05*(1+–0.05)	4,929
2009	6,875	6,875	1.0500	1.05*(1+0)	7,219
2010	6,788	6,788	1.0500	1*(1+0.05)	7,127
2011	5,800	6,960	1.0000		6,960

5800*12/10

Projecting gross loss ratios

Year of Account	*On-level Gross Premium*	*On-level Net (20% brokerage) Premium*
2007	4,468	3,574
2008	4,929	3,943
2009	7,219	5,775
2010	7,127	5,702
2011	6,960	5,568

Year of Account	*Ultimate Claims*				*On-Level Net Ult LR*
	IDM	*BF prior*	*BF emerging*	*Selected*	
2007	4,161			4,161	116.4%
2008	507			507	12.9%
2009	1,645			1,645	28.5%
2010	3,556			3,556	62.4%
2011		3,062 (=55%*5568)	2,297 (=0.75*3062)	4,257 (=1960+2297)	76.5%

Candidates generally dealt with this question quite well, but very few got close to scoring full marks. Candidates scored most highly where workings were shown clearly. Most candidates were able to calculate gross premium and on-level gross premium, as well as ultimate claims up to 2010. However many made a mistake when calculating on-level net premium, by taking off brokerage for that particular year rather than the flat 20%. Nearly all candidates ignored the fact that the data was at March, so the final year's premium needed to be grossed up by 12/10 to get the ultimate premium. A significant number were unable to use the BF method for ultimate claims in 2011.

(iii) Selecting 2012 Ultimate Loss Ratio

LR (net of comm.)	57.5%	(Volume All Average)
	59.3%	(Simple All Average)

Most candidates were able to use a suitable average, or censored some data with clear explanation, both of which were acceptable.

7 (i)

Policy details

- cover level (there might be a choice of limits or insured illnesses)
- excess points (current and historic)
- type of pet (cat/dog/rabbit/horse etc.)
- dates of cover (start, end)
- dates of any changes in cover
- details of any specific exclusions

- premium amounts (written)
- premium payment method/frequency
- policy number
- name of pet or pet identifier

Rating factors

- postcode / area / location
- Breed (including pedigree/cross flag)
- Age/DOB
- Gender
- Neutered/spayed
- Pet weight
- Owner's attributes (e.g., age, occupation)
- Sales channel
- Number of other pets
- Identity tagged/chipped
- NCD/past claims
- Pre-existing conditions

- other valid rating factor

Claims details

- unique claim ID
- link to policy details
- claims amounts paid and dates
- excess
- payment type (indemnity, fees etc)
- outstanding amounts and dates
- currency
- rating factors at time of claim
- date of claim event
- date claim made (reported)
- open/closed/reopened indicator
- date closed (if applicable)
- cause/type of claim (e.g. type of illness)
- location of vet

Candidates were generally able to list many points in this part. However, many made no mention at all of claim details or else just mentioned it briefly in relation to policy details. Some were unable to come up with sensible rating factors for pet insurance.

(ii)

Data Definition Problems

The data could be of poor quality, e.g. missing, or containing lots of errors.
It might not be detailed enough. For example:

- insufficient data fields or too grouped
- they may not collect information on rating factors that we use
- the other insurer might capture different data items to us – for example, dog breed group rather than exact breed.

If the other company sells through brokers who do lots of the admin of policies and/or claims then the data might be less detailed.
If the other company uses more than one distribution channel then the data might come in lots of different formats depending on the channel.
This could create a need to contact the policyholder prior to renewal, to get the required information, or a need to make assumptions when calculating premium rates.
The data might be in a very different format from ours, e.g. policy numbers might have a different format.
The definition of a claim might be different. For example, for ongoing health problems where a pet needs treatment every month, are the monthly claims treated as separate claims or linked together as one?
If this definition differs for the two insurers then the calculated frequencies and severities won't be comparable.
There could be different treatment of expenses & fees or excesses.

Inconsistent claims estimate methods underlying the data.

The above problems could lead to:

- Incorrect information on performance of the book, leading to incorrect management decisions.
- Loss of profits through pricing too low
- Loss of profitable volume through pricing too high.
- Antiselection through using an incorrect rating structure.
- Inappropriate reserving.
- Incorrect capital held, leading to possible solvency problems or regulatory intervention.
- Failure to make recoveries from reinsurers.

Processing Problems

Policies may have features that can't be accommodated in our system.
So we either have to build it in or change the policy, which either costs IT money or risks attrition.
The two systems may be incompatible i.e. not able to link up for the purposes of transferring data.
We may need to maintain two different sets of systems, leading to extra ongoing costs, or spend time and money finding a suitable IT solution, or manually transfer data, which could be open to errors.
Data volumes may overload the system.

There may be "pipeline" problems with transferring records that are partway through a transaction, such as a purchase, renewal or claim.
In these cases the transfer may omit historical information that is needed to close the transaction properly.
Payment processing to customers, refunds, commissions, aggregator fees etc: we need to ensure these are not missed or duplicated.
Currency treatment might be inconsistent.

If the imported policy is for a customer we already have (with a different type of policy), then we will need to synchronise the customer record.
Similarly with claims supplier records.

The consequences of the above may be incorrect payments to customers or suppliers; poor customer service and loss of reputation.

Legal Problems

Customer data may be subject to data protection laws, which may limit the use of data.
Contravening these laws could lead to criminal prosecution and unfavourable publicity, so permission may need to be obtained for use of personal data when a policy is issued or renewed.

The focus of this part was on problems in integrating data and was quite poorly answered relative to other questions on the paper. Some candidates focused too much on one particular area (for example, all the errors there could be in a given dataset); others went off at a tangent (for example, covering in great depth how to deal with data problems in subsequent GLM analysis). Few candidates came up with sufficient distinct ideas to score well, and only a small number gave sufficient points on the consequences of data integration problems.

8 (i)

- Reinsurer agrees to indemnify the cedant for an amount above an excess.
- Cover is up to a specified limit.
- Cover is non-proportional.
- It is a form of aggregate XoL.
- It is used for very high aggregate losses.
- Coverage is for an accumulation of losses due to a specific event.
- For example, storm, flood, freeze.
- Event length limited via an hours clause.
- Hours clause is commonly 24 or 72 hours (96 for freeze) *(one of these is sufficient to score)*
- Cedant chooses start point of period.
- Usually an insurer will have a stack of layers.
- There may be reinstatements.
- The excess point and upper limit may be indexed in a stability clause.
- The policy is normally renewable annually.
- Cover is provided under a treaty.

This part was generally answered well.

(ii)

- Allows insurer to accept risks that could lead to large claims.
- Reduces the risk of insolvency from a catastrophe.
- Mitigates concentrations of risk.
- Stabilises the technical results of an insurer by reducing claims fluctuations i.e. smoothes profits.
- This can assist with business planning.
- Helps make more efficient use of capital by reducing the variance of the claims payments.
- Lower the regulatory capital.
- May be better value than alternatives.
- Can improve financial strength (eg in the view of ratings agencies).
- May be a regulatory requirement.
- Increase capacity to write a greater volume of business.

This part was generally answered well.

(iii)

- What cat model is used (e.g. proprietary/internal)?

- What version of the model is used (or how up-to-date is it)?
- Is secondary uncertainty modelled?
- What are the key areas of uncertainty in the model?
- Which perils are modelled?
- Which territories are modelled?
- Is the exposure complete/reliable?
- How recent is the exposure data?
- Is the exposure data likely to change materially over the period of coverage?
- Are losses after all other reinsurances?
- What options are turned on, e.g. demand surge, business interruption, fire following quake, storm surge?
- What is the definition of "year"?
- What are the definitions of the events?
- What are the probabilities or return periods of the events?
- Is the loss amount the ground-up, uncapped amount?
- Is the loss amount indemnity only, or are other elements included?
- What currency conversion rates have been used?
- What hours clause has been assumed?

This part was generally answered quite well, but some candidates scored poorly, being unable to come up with enough ideas.

(iv)

Xs	10	10
Lim	5	20

Event No.	*Layer 1*	*Layer 2*
954443	5.00	10.30
954444	–	–
954445	–	–
954446	3.10	3.10
954447	5.00	5.00
954448	5.00	20.00
954449	5.00	20.00
954450	–	–
954451	1.30	1.30

Equivalent credit was awarded if effect of reinstatements was calculated in the above.

	Unlimited		*Limited*	
Year	*Layer 1*	*Layer 2*	*Layer 1*	*Layer 2*
467	8.1	13.4	8.1	13.4
468	15.0	45.0	10.0	40.0
469	1.3	1.3	1.3	1.3

Assumption: cover is annual, so there is one reinstatement per year.

Most candidates made a reasonable attempt at this part. Common mistakes included:

- *Confusion over what £5m XS of £10m would pay out, and when.*
- *Failure to allow for the reinstatement, or to limit the policy to only one reinstatement.*
- *Confusing the mention of "rate on line" with lines of cover (as in surplus RI).*

Candidates who showed their workings could recover marks despite minor slips, such as arithmetical mistakes. Candidates who failed to do this tended to forfeit valuable marks for small mistakes.

(v) (a)

AAL	0.5	0.8
Premium	1.0	2.4
	=5*0.2	=20*0.12
RI LR	50%	33%

(b) Since Layer 1 is a subset of Layer 2, the implied loss ratio for the layer 15 xs 15 is 0.3 / 1.4 = 21%

Relatively few candidates realised that £15m XS of £15m was the difference between the layers being priced in the question.

(vi) The average annual loss of £0.5m will include some years where the cover was completely burnt through for the first time and some where there was only partial use of the cover or none at all.

The treaty will specify the mechanics of reinstatement, which would normally be after each recovery (pay-as-you-go). Although not market practice, credit is also given for assuming that reinstatement takes place after the cover is completely drained.

Year	*Loss (after reinstatement)*	*Comment*
467	8.1	Full reinstatement required
468	10.0	Full reinstatement required
469	1.3	Partial reinstatement required

The above is not required to score and is for illustration only.

Calculate for each year the amount of cover that needs to be reinstated as a result of the modelled loss events in the year. Let this be C_{467}, C_{468} etc. Expected total losses to the contract are unchanged and the required LR is the same, so expected premium including reinstatement premium is also required to be the same.

Suppose new RoL = R.
The reinstated cover is C_i for each year i, so the reinstatement premium is 50% of RC_i.

Expected total premium = $1 = 5R + R\Sigma C_i / 2n$, where n is the number of years in the event set.

So $R = 1 / (5 + \Sigma C_i / 2n)$.

Alternative solutions based on variants of the above are acceptable if correct and properly explained.

Few candidates attempted this part. Those who did attempt it tended to try to give a figure, rather than an explanation. Very few noticed that only a partial reinstatement premium would likely be payable where the original layer was only partly burnt.

END OF EXAMINERS' REPORT