EXAMINERS' REPORT

April 2010 examinations

Subject ST8 — General Insurance: Pricing Specialist Technical

Introduction

The attached subject report has been written by the Principal Examiner with the aim of helping candidates. The questions and comments are based around Core Reading as the interpretation of the syllabus to which the examiners are working. They have however given credit for any alternative approach or interpretation which they consider to be reasonable.

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Chairman of the Board of Examiners

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Comments

These are given in italics within the solutions that follow.

1 (i) Track/path, maximum wind speed, storm radius, forward speed, rate of decay of wind, probability/frequency
Duration and time of year are not valid points.

This question was reasonably well answered but definitions were sometimes technically weak; for example, the general term "location" might be given rather than the more specific "track/path"

(ii) Tornado, hail, earthquake, winter storm, Californian wildfire, flood/storm surge

Typhoons and cyclones are hurricanes and covered under (i). Disease and tsunami are not commonly modelled using cat models and are therefore not valid answers.

This question was generally well answered, although some candidates seemed to be following a "scattergun approach", listing all possible catastrophes and evidently hoping that correct ones would get marks. Some candidates listed non-natural perils in this approach. The examiners were looking for perils that are commonly treated with models.

2 (i) Risk factor: a factor that is expected to have an influence on the intensity of risk in an insurance cover, possibly with the support of statistical evidence.

Rating factor: a factor that is used to determine the premium rate for a policy, that is measurable in an objective way and related to the intensity of the risk. It must, therefore, be a risk factor or a proxy for a risk factor or risk factors.

This question was generally well answered, but only a few candidates mentioned statistical evidence

(ii) A risk factor might be predictive but impossible to measure/verify
For example, driving skill, traffic density (or similar valid example)
Or it might be susceptible to manipulation by the policyholder and therefore not objective.
In this case rating factors are required as proxies.
For example, policyholder age, occupation and postcode as proxies for driving skill/time on the road
Claim-free years and NCD are also proxies and substitutes for experience rating.
Rating factors should not be closely correlated to other rating factors
They should be acceptable to the market
And permissible by regulations/law

Some of the points in (ii) might well have been made as valid points in (i), and would have been given credit accordingly.

These examples are strongly linked to motor; answers that referred to other classes of business are perfectly valid.

This question was reasonably well answered but on the whole answers should have been communicated more concisely.

3 (i)

- The system would typically include:
  - a data capture process;
  - calculations and/or manipulations on the data;
  - a process for reporting the results.
- Output should be concise and focused on the specific goals of the organisation.
- Examples:
  - The aim to reduce the lapse rate for profitable policies) or other valid example of focus)
- Output should be oriented to decision-making.
- And produce lapse rates by all important parameters
  - Such as rating factors
  - Regions
  - Distribution channels
- Examples:
  - Flag where lapse experience is outside of tolerance and action is required. [Or other valid example of decision-orientation]
- Data and results should be reliable and validated (as part of the actuarial control cycle).
- Examples:
  - Compare historic mix of business with later renewal experience. [Or other valid example of validation]
- Data should be complete
- Calculations should be well-defined but not over-complex.
- Examples:
  - Lapse volume should have a clear definition of how it treats policies not taken up, cancelled mid-term or "churned" to another policy type. [Or other valid example of calculation clarity]
- Data should be easy to collect.
- System should be documented,
- extendable
- and low-maintenance.
- System and output should be clear and easy to use
- Inputs and outputs should be consistent over time and with other analyses.
- Examples
  - If definition of lapse rate changes then it should be restated for all time periods.
  - Lapse rates reported at the same level of granularity as other business metrics. [Or other valid example of consistency]
- Results should be available as soon as possible after experience has occurred.
- Clear ownership and responsibilities for various part of the system e.g. data entry, changing output.
- Staff need to be kept trained and competent
- Limited access to the system e.g. only certain people can enter new data
- Linked to and/or compatible with other systems.

- Input should be consistent with other data sources.

Most candidates did not give a sufficiently detailed answer, some selecting a small number of points and discussing them in detail. Some candidates gave formulae for calculating lapse rates, which was not an answer to the question and gained no credit.

(ii) *Policy-by-policy data*

- Cover type at date of lapse
- Commencement date or duration in force.
- Effective renewal date.
- Actual renewal date if renewed.
- Cancellation date if cancelled.
- Key rating factor and policy details at time of renewal (if segmented analysis)
- Premium immediately before renewal.
- Renewal premium offered.
- Actual renewal premium after any negotiated discount.
- Source of business e.g. internet, broker, phone, special promotions and campaigns
- NCD/claims made record
- Reasons for lapse
- Declinatures need to be removed from exposed to risk
- Whether or not there is an open claim

This question was generally well answered.

(iii)

- It takes time for lapse experience to emerge because there is likely to be a range of dates between which the policyholder could call to cancel.
- Therefore it will take time to know whether or not initiative is working
- We need to know lapse rates before and after the initiative to see if it has worked
- Therefore the monitoring system needs to be in place well before the initiative starts
- To contain the delay in emergence of lapses: if there is no deadline for renewing then impose one; if there is then enforce it.
- To give timely output, the company could project ultimate lapse experience from the limited initial experience, for example by using triangulation methods.
- These methods could be unreliable because new operational initiatives might change the development pattern of lapses.
- In this case the company needs to apply judgment or a prior view of likely experience to the projection method.
- The operational initiatives might affect different groups of policyholders in different ways, which could distort an aggregate analysis.
- Monitoring could be broken down into sub-groups to help with this.
- However, this could make the emerging experience more volatile.

- Lapses could be affected by other initiatives, such as a sales promotion running at the same time or competitors' activities.
- Where possible, avoid running initiatives at the same time.
- Lapses could also be affected by changes made in past years that have affected the mix of business coming up for renewal.
- It might be possible to collect data and build a model, such as a GLM or time series analysis, that removes the effect of other factors, leaving just the effect of operational changes.
- Look at changes in call centre statistics to see if they have changed at the same time

This question was reasonably well answered but candidates tended to focus on the issues of running initiatives at the same time as competitor activities to the detriment of other valid points. There was a general appreciation of the difficulty of assessing the effect of initiatives when a lot of other influences are present and changing.

4 (i) A soft insurance market is one in which prevailing premium rates/terms and conditions generally do not allow insurers to write business (sufficiently) profitably.
Low premium rates are not a sufficient answer, and did not receive full credit.

Definitions should have been stronger explicitly, referring particularly to business not being <u>sufficiently</u> profitable. Some candidates provided a detailed discussion of the insurance cycle, which was not required and tended to obscure any valid parts of their answer.

(ii)

- Insurers may not realise that business is unprofitable at current rates
- For example because of:
  - Inadequate data on claims experience
  - Poor expense allocation
  - Poor capital allocation
  - Over-optimistic persistency assumptions
    (or other valid examples)
- Profitability may not be the prime driver, e.g. for a captive
- They may write niche business that bucks the trend
- …or have a strong brand that allows them to keep rates higher than the market
- They may not want to lose market share and therefore market standing
- …and therefore miss out on profitable business when conditions improve
- …or incur costs of re-entering the market
- It can be difficult for insurers to reduce their overheads quickly when volumes reduce
- Therefore, it may be better to keep volumes artificially high as long as each policy is still making a contribution to overheads

- Reinsurance rates may be even softer, so a gross loss may give a net profit
- Class of business may diversify against rest of the book thus keeping capital requirements low. Pulling out may significantly raise capital requirements
- Capital requirements may reduce when the premium is reduced
- There may be opportunities to cross-sell profitable lines of business
- Turning away business or exiting a line might be regarded as a sign of weakness
- The insurer might believe that an improvement in the market might be imminent
- Exiting the market may be prohibited by the regulator

The fact that the insurer might have lots of capital is not a valid answer.

(iii)

- Withdraw from an entire line of business
  - Eliminates unprofitable business provided overheads can also be reduced
  - May be seen as positive, decisive move by shareholders/stock market
  - May reduce market standing overall, leading to lower business in other lines
  - Will probably cut out some profitable business as well
  - May be difficult to re-enter market if desired later
  - Reduces diversification
  - May incur a one-off cost of change (e.g. severance)
- Continue writing same business but reduce exposure
  - Examples: Follow, rather than lead; Reduce line sizes; more RI
  - Reduces loss in a very soft market without having to withdraw
  - Shares part of the problem with the reinsurer
  - …but may damage relationships
  - Not helpful if business is still marginally profitable because overheads are still the same
  - May fail now to cover fixed expenses
- Reduce expenses, for example though cost-cutting or renegotiating commission
  - Increases profitability overall
  - May cut investment, future opportunities etc
  - This may damage relationships with brokers
- Continue writing business but at lower premium rates
  - May make it easier to retain key clients and renew them profitably in future
  - Reduces ROCE for the business
- Increase/ stand fast on premium rates
  - Danger of business volumes collapsing
- Continue writing business but be more selective of risks
  - Maximises ROCE
  - May need more underwriting effort and therefore cost more
  - May erode relationships with brokers

Parts (ii) and (iii) were reasonably well answered, but many candidates would have benefited from having more structure around their answer making points clearer and more succinct and in context of sub headings. The most common fault was to provide answers that did not cover sufficient points.

5 (i) (a) 3.03 – 2.05 = 0.98
(b) 3.18 – 2.68 = 0.50

A number of candidates got this wrong, many dividing rather than subtracting the factors.

(ii) Premium / ILF (Option A) = 20,000/0.98 = 20,408
Premium / ILF (Option B) = 10,000/0.50 = 20,000

Based on the above calculation Option A is the better option, as it gives more premium per unit of risk Credit would have been given for similar calculations and explanations.

This question was reasonably well answered, but a fair number of candidates got the logic the wrong way round and determined that B was the better option.

(iii) Possible comments

- The analysis gives only a relative measure between the two layers. Both may be very poorly priced.
- The difference in profitability is only very small. Difficult to confidently recommend one over the other.
- The ILF may not be appropriate for this type of business;
- The ILF is based on losses only. Profit requirements, expense loadings etc. may differ proportionally between the two layers.
- Volatility of loss experience may be different for the two layers.
- Option B may be outside the insurer's aggregate limits.
- The higher layer may be longer-tailed and therefore attract more investment income and require a lower premium for the same expected losses.
- The fit with and cost of our own reinsurance programme should be considered
- ILF are based on unlimited coverage
- Any other sensible limitations.

Answers given tended to concentrate on the general point of the ILF not being appropriate for the particular business being considered and missed out on the specific points. Very few candidates noticed that the difference between the two was very small or that one being better than the other did not of itself imply that either was an acceptable risk.

(iv) A possible alternative approach to the answer given below would be to calculate each year separately and average. This was acceptable and would have received equal credit.

Mid point of ILF period = 1 July 2009
Mid point of policy period = 1 July 2012

Inflationary period = 3 years
Inflationary factor = $1.05^3 = 1.157625$
Inflated 100k limit = 115,763 (ILF = 1.00 still)
Inflated 200k limit = 231,525 (ILF = 1.47 still)
New ILF for 100k = $1.00 \times 100{,}000/115{,}763 = 0.86384$
An alternative approach is to extrapolate backwards from 100,000 rather than interpolate between 0 and 100,000. This is acceptable and this answer becomes 0.936.

$$\text{New ILF for 200k} = \frac{(231{,}525 - 200{,}000) \times 1.00 + (200{,}000 - 115{,}763) \times 1.47}{(231{,}525 - 115{,}763)}$$

$$= 1.342007$$

ILF for 100k xs 100k = 1.34201 – 0.86384 = 0.47817

Assumptions

- Inflation is the same for claims of all sizes
- Inflation is same in future as in past
- Can interpolate between bottom 2 ILFs
- Can validly extend ILF below the lowest value
- Uniform incidence risk over 3 year contract

This question was reasonably well answered but the layout of results was often not logical, which was disappointing as this is straight from core reading. The presentation of results was often very unclear, which made it difficult to tell whether an answer that was different from the model solution used a valid alternative approach (which would have gained full credit), resulted from a calculation error (which would have gained appropriate partial credit) or was wrong.

6 (i) Linearly interpolating to the mid-point of the policy year gives a 75% (9/12) weight on the previous date and 25% (3/12) on the next date.

Year of Account	*Interpolated GT (m's)*
2007	1,924
2008	1,982
2009	2,025

For the 2010 policy year any sensible assumption would have received credit provided it was justified by the candidate. For example a 0–10% increase on the basis of recent historical growth, although 10% would be well above trend and should have been accompanied by a reason that showed that the candidate was aware of this. Having stated their assumption, candidates were expected to apply it correctly.

The rest of the solution uses +5%, giving 2,127m.

Not many candidates determined or justified an assumption to be applied for the future. Many candidates interpolated not to the middle of the policy years but to their start, which was significantly less appropriate but also required extrapolation beyond the start of the data.

(ii) Projections

	total loss	*large loss reduction*	*non-large*	*development factor*	*ultimate non-large*
2007	3,317,000		3,317,000	1.0526	3,491,579
2008	8,600,000	4,500,000	4,100,000	1.6667	6,833,333
2009	15,000		15,000	2.2222	33,333

This was generally well answered, many candidates getting full marks.

(iii) Using the BF method with exposure measure GT
Alternative methods were acceptable, such as using an expected value. However, to be acceptable a method had to be more suitable for immature years and take account of the fact that our exposure measure is GT rather than premiums or anything else.

This was moderately well answered although not many candidates explicitly mentioned GT as exposure measure or suitability for immature years.

(iv) One method based on all years having equal weighting is shown below. Credit was given for:

- Realising we need to calculate an historic claims / exposure
- Correct calculation of claims/exposure
- Sensible selection of claims/exposure
- Apply the selected ratio to the projected exposure
- Appropriate assumptions

It is acceptable to leave out 2009 because it is immature but this should be explicitly justified; with 45% of claims expected to be reported it is not very immature and the fact that losses to date have been very low is not a good reason for ignoring it.

Year of Account	*GT (millions)*	*Ultimate Claims*	*Claim per million GT*
2007	1,924	3,491,579	1,815
2008	1,982	6,833,333	3,448
2009	2,025	33,333	16
Total	**5,931**	**10,358,245**	**1,746**
		Selected	**1,746**
2010 (Projected)	2,127	**3,713,742**	1,746

A simple average is acceptable for full marks, but examiners were looking for a sensibly justified approach.

This question was generally well answered.

(v) Two methods are shown below. Credit was given for either.

Remaining large claim	4,500,000
Method 1	
Number of years	3
Claims per year	1,500,000
Large Loss	1,500,000
Method 2	
Historical total GT	5,931
loss/exp year	4,500,000/5,931 = 759
2010 Exp	2,127
Large Loss	1,613,809

Marks were deducted if 5 million was used without adjustment.
Candidates may have interpreted "loading" as either a proportionate loading or a rate per exposure year; either was acceptable.
Candidates might have spread the loading over more years if they justify this, but spreading over fewer years was not given full credit.
The important things in this question were the use of 4.5 million and properly-argued spreading.
This is a prime example of many approaches being correct. The key thing is for the candidate to explain their assumptions.

This question was generally well answered.

(vi) (a) All historical claims should be trended for inflation onto 2010 terms

(b) Historical claims which were just below the deductible may be above the deductible after trending
Hence historical claims may be understated
This can be solved by using individual claims from the ground up.

Many candidates could have been more explicit that historical claims may be understated. Many candidates talked at length about inflating the XS point but this was not required.

7 (i) Policy data

- Class of business
- Dates on cover.
- Policy limits and excess points (current and historic).
- All other rating factor and exposure measure details
- Historical exposures
- Any changes to rating factors during the period.
- Premiums charged.
- Type of coverage and details of any exclusions.
- And any changes to coverage historically.
- Location of risk
- Currency of premium

No credit for things like policyholder name that are not part of the analysis

Claims data

- Date of claim event.
- Whether the claim is open, closed or reopened.
- Date closed (if applicable).
- Date reported.
- Dates and amounts of payments.
- All claims from ground up.
- Payment type; for example, indemnity cost, lawyers' fees and adjustors' fees.
- Dates and estimates, if they exist, of amounts outstanding.
- Rating factor details at time of claim [no credit if changes to rating factors also mentioned in policy data].
- Type of claim.
- Type of peril.
- Policy number/code to link to policy information.
- Currency of claims
- Cause of loss

No extra credit for mentioning claims link to policy as well as policy link to claim.

No credit for unique claim ID since not needed for price.

Other data

- Clear definition of all data fields (metadata).
- Expected volumes, premium sizes and mix under the new panel.
- Details of other underwriters expected to participate.
- Dates when rates will be in force.

This question was generally well answered.

(ii) "Sources" can reasonably be interpreted as "causes".

Errors

- Data integrity or classification errors can cause policies & claims to be allocated to the wrong risk groups and distort the analysis,
  - leading to incorrect rates.
- For example:
  - Claim details recorded against the wrong claim.
  - Link between claim and policy information incorrect or inconsistent.
  - Risk or policy condition details at the time of claim incorrectly provided as the risk details at some other point in time.
  - Incorrect claim type or cause.
  - Unclear claim type e.g. water damage may be flood, burst pipe, sprinklers…

  Credit would be given for valid alternatives
- Missing data/blank fields
- Claim dates and amounts could be incorrectly provided,
  - which would cause allocation of claims to the wrong period and distorted development/payment patterns.
- For example:
  - Notified dates instead of accident dates.
  - Where the accident date is difficult to determine, such as liability and subsidence.
  - Incorrect payment dates/amounts.
  - Changing basis for case estimates .

  Credit would be given for valid alternatives
- Since B is terminating the arrangement with S, S may take little care over data quality or may withhold some data.
- The precise meaning of data definitions could be misinterpreted by B, such as exactly what is included in premium or treatment of return premiums.

Distortion

- If claims are not coded at a low enough level (e.g. type or cause) then a change in the mix of business could distort claims development patterns.
- Inflation of claim payments may distort the monetary amounts being used in claims data analysis unless the raw data is adjusted or the estimation method can make a suitable allowance.
- Changes in claims handling practices over time can distort statistics and development patterns/
- For example:
  - Recognising a claim.
  - Recording nil claims.

  - Marking a claim as settled.
  - Delays & backlogs.

  Credit would be given for valid alternatives
- Unusual features in the period being considered can distort the analysis, such as large claims or catastrophes.

There was reasonable coverage of data errors and blank fields, but distortions were not well covered. Poorer answers tended to be too brief.

(iii)

- U may wrongly decide to participate or not.
- U might make a wrong decision on the need for a rating review after comparing actual experience with expected.
- This might be because:
  - U has modelled expected experience incorrectly.
  - U had to leave a wide margin of error in monitoring, given the uncertainties in the data.
- If there is distortion of the true distribution of business or claims amongst risk groups then U might make a wrong decision on whether to accept or decline particular types of risk.
- As a result, U could suffer underwriting losses through a high panel share of unprofitable business or a loss of potentially profitable panel share.
- If panel share is much lower than expected then U may not be able to cover fixed expenses of participation.
- Antiselection is very likely if the rating structure is inadequate, since the panel arrangement enforces competition purely on price between underwriters.
- It may also be difficult to recover any lost profits after the first year of underwriting each policy, since the business is rebroked at renewal, especially in competitive classes such as these.
- It could lead to bad reinsurance decisions
- Or bad capital decisions
- Or other bad management decisions
- Exposure measures may calculated wrongly
- Ultimately this may lead to pricing wrongly

Answers often concentrated on prices being too low or too high and on anti-selection, to the exclusion of other points. In addition the answers on these points did not go into sufficiently well explained detail in many cases. The most fundamental point – that U may make the wrong decision on whether or not to participate – was rarely mentioned.

(iv)

- Take a prudent view of future experience and reflect this in the pricing structure.
- For example:
  - Conservative assumptions in models.
  - Explicit loadings for uncertainty in pricing models.
  - Fully loaded expenses.

Credit would be given for valid alternatives.

- Examine the sensitivity of the models to assumptions, particularly looking at whether it drives a decision on whether to participate.
- Request B to carry out a "what if" analysis of a draft rating structure and set of decline rules to see what business would be won at what price.
- Consider declining sole traders or only writing a subset of these risks until actual experience becomes available.
- Consider only accepting liability covers with low limits & exposures until actual experience becomes available.
- Request details from B of the performance of business that U declines, to assess whether decline rules can be relaxed.
- Benchmark by using data from similar lines of business already written as a cross-check on the experience supplied by B or to help set rates.
- Put in place monitoring of key statistics, such as volumes, premiums, mix of business and panel share to spot possible problems early.
- Ensure that U can model and change rates quickly and that B agrees to implement them quickly.
- Have a profit sharing arrangement so that B has a financial interest in the success of the underwriters
- Checks on data input
- Use more reinsurance, reducing the retention to reduce risk.

Answers tended to concentrate on benchmarks and internal/external data to the exclusion of other points. Even the most basic actuarial principle of adding a margin to the basis was missing in many cases.

8 (i) Data

- It should be established first whether the data are correct.
- Examples:
  - Whether the numerator and denominator of the claim frequency correspond.
  - Whether treatment of nil claims is correct.
  - Statistical quality of data (is there enough?)
  - Policyholders may falsely claim to have the appropriate alarms
  - It is possible that some customers installed their alarms after they were burgled and this distinction may not have been picked up

Time period

- The period of experience used may have a large effect on the figure.
- Examples:
  - Time period might not correspond with that used for pricing (e.g. too old to be relevant or too recent to have shown in pricing yet)
  - Time period may be very short and statistically unreliable.
  - The periods may not be consistent for both sets of policies

There is more to price than claim frequency

- (no credit for saying theft is not the only peril)
- The cost of theft claims depends on claim amounts, not just frequency.

- So it is worth looking at how average claims cost varies by type of security.
- The customer price may change differently from claims cost across levels of a rating factor if the company does not use constant loadings for profit etc across the book.
- Even if the claims cost is lower for lower security measures, the company would probably want to charge premiums that are intuitive to sellers and that do not encourage adverse policyholder behaviour.
- People without alarms may have lower-valued contents and may therefore may be less tempting as burglary prospects or be less likely to submit a claim.
- There may be a degree of moral hazard: people with alarms may be less careful in other ways.

Modelling

- The exposure for this type of security measure might be low in the data used for pricing, so worth looking at whether it has been smoothed judgmentally by the modeller.
- The Claims Director appears to be quoting a one-way analysis from the data and comparing it with the output of a GLM.
- A one-way analysis can misstate the true relativities if good experience for better security measures is masked by a correlation with another factor that results in poor experience, such as the location of the property.

Most candidates got marks for noting that other rating factors interacted in a complex way with burglar alarms and that severity was an issue, usually with well-explained examples. More general points such as "we should investigate" were missed.

(ii)

- A two-way analysis by each combination of the level of security together with another factor.
  - This would show key statistics such as exposure and theft claims frequency in graphical form for ease of understanding.
  - The goodness of fit of the model to the data should be investigated.
  - Valid example of possible factors, such as by security and postcode area so it can be seen how they tend to move together.
- A correlation analysis that shows the extent to which claims frequencies for levels of different rating factors tend to move together.
  - For example, Cramer's V statistic, where values close to 1 for level of security would indicate a high level of dependency with other rating factors.
  - The results would be presented as a matrix of values for each combination of rating factors.

This question was generally poorly answered. The critical points are that analysis needs to cover the interaction between factors and identifying the methods for these analyses.

9 One possible approach is shown below, but candidates may have approached this question from the opposite direction. That is, they went straight to (b) and worked out the credibility on the basis of an x% probability of being within y% of the true mean. If they looked to show that the actual number of claims is less than the number needed for full credibility and conclude from that that it is appropriate to give only partial allowance for own losses then that would have received appropriate credit (subject to the calculation being right). They needed to complete the first half of the answer to get the credibility-weighted claims rate.

(a) The number of claims in the period is probably best represented by the Poisson distribution, but with this many claims it is reasonable to use a normal approximation.

The expected number of claims is 1,000 * 0.16 * 9/12 = 120

Assume that claims are likely to be evenly spaced through the year. (Many candidates mentioned that in fact this was far from certain.)

The standard deviation is the square root of this, or 10.954.

The actual number of claims is 11 below expected; making a continuity correction we use 10.5, which is 0.959 standard deviations.

The probability of a result this low is $\Phi(-0.959) = 0.1689$, or 16.9%.

The probability of a result this far from the mean is 34%.

This means that the result is rather more probable than is normally considered appropriate to allow full credibility in setting premium rates. However, it is extreme enough that it would be normal to allow some influence of the actual experience.

This question was poorly answered with very few candidates carrying out the above analysis. A significant number of candidates questioned the background they were given in the question, which they should have taken as assumptions.

(b) It may be appropriate to allow full credibility when the probability of being within 10% of the mean is 90%. (Any other sensible combination would have been accepted. This is probably the most generous to be allowed without any caveats.)

This means that the number of claims for full credibility is given as follows. A number of choices for the combination of probability and tolerance are given.

Probability	90%	95%	90%	95%
Tolerance	10%	10%	5%	5%
	$[\Phi^{-1}(½(1+0.9))/0.1]^2$	$[\Phi^{-1}(½(1+0.95))/0.1]^2$	$[\Phi^{-1}(½(1+0.9))/0.05]^2$	$[\Phi^{-1}(½(1+0.95))/0.05]^2$
=	$[1.644584 * 10]^2$	$[1.955996 * 10]^2$	$[1.644584 * 20]^2$	$[1.955996 * 20]^2$
=	271	384	1,082	1,537

The expected number of claims is 120, which gives a credibility factor of

	$(120/271)^{0.5}$	$(120/384)^{0.5}$	$(120/1082)^{0.5}$	$(120/1537)^{0.5}$
=	0.665	0.559	0.333	0.279

The actual reported rate of claims is 109/1000*12/9 = .145
The credibility-weighted rate of claims is therefore

(0.145*0.665+ 0.16*0.335)	(0.145*0.559+ 0.16*0.441)	(0.145*0.333+ 0.16*0.667)	(0.145*0.279+ 0.16*0.721)
= 0.150	0.152	0.155	0.156

This question was reasonably well answered when it was attempted, although answers could have been much better laid out into logical steps. Too many candidates decided that credibility theory was not an appropriate approach, despite being told to use it, and did not answer the question. The point of the question was to determine whether or not candidates could apply credibility theory, not to see whether or not they could evaluate its appropriateness in a particular case. Some used apparently arbitrary weighting factors.

10 Financial reinsurance and co-insurance do not get any credit in this question.

The company is said to be well capitalised, but it is small. Therefore it may use quota-share reinsurance for diversification.
or if it is a recent entrant to a class of business.
It might take surplus reinsurance, in which it can choose the level of its retention for each risk, in order to defray larger risks.
It will almost certainly take out risk excess of loss insurance on its whole book. This refunds every claim that exceeds a certain amount (the retention) up to a maximum higher amount (the limit). The limit should be chosen so that it is very unlikely that any single claim will exceed it. This will also stabilise losses, protect against insolvency and may give the company access to technical help, which is especially important for a small company.
It will also need catastrophe excess of loss for the property book. This gives similar cover to excess of loss, but relates to events – catastrophes – that cause a large number of claims but not necessarily any claims that are large in themselves. Such a policy contains an "hours clause", defining the maximum period of time over which claims may be added for this cover.

The liability book may be covered by aggregate excess of loss, under which claims from the same cause may be aggregated for an excess-of-loss claim, without having to occur within the same short period.
The company may seek stop-loss insurance, covering all or part of the book of business from an unusually high loss ratio; generally claims in excess of a specified loss ratio up to a loss-ratio limit would be covered. Such cover is often difficult to obtain, and therefore may not be held.
The company may take out an industry loss warranty.
In which its recoveries are based on losses to the industry as a whole.

This question was reasonably well answered although candidates missed easy marks for not describing the cover in sufficient detail.

END OF EXAMINERS' REPORT