INSTITUTE AND FACULTY OF ACTUARIES

EXAMINERS' REPORT

September 2012 examinations

Subject ST8 – General Insurance: Pricing Specialist Technical

Introduction

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 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. The Examiners have access to the Core Reading, which is designed to interpret the syllabus, and will generally base questions around it but are not required to examine the content of Core Reading specifically or exclusively.

For numerical questions the Examiners' preferred approach to the solution is reproduced in this report; other valid approaches are given appropriate credit. For essay-style questions, particularly the open-ended questions in the later subjects, the report may contain more points than the Examiners will expect from a solution that scores full marks.

D C Bowie
Chairman of the Board of Examiners

December 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 actuarial 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 September 2012 paper

The level of difficulty of the paper and the general performance of candidates were 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 no significant evidence of time pressure amongst candidates around the pass-mark area.

Several candidates displayed poor handwriting at this sitting, which made it difficult for examiners to award full credit. Candidates with a disability that affects the readability of their handwriting are asked to contact the Examinations Team well in advance of the sitting for advice on what support may be available.

Question 1 asked candidates to describe how to determine a measure of exposure for pricing, but most candidates misinterpreted it as a generic question. Scores were generally very low as a result.

Apart from Question1, Questions 6 and 7 produced the lowest ranges of scores because candidates either failed to think widely enough, or put down generic points, rather than dealing with the specifics of the question.

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 include these areas in their revision.

1

- Historic exposure is required
- …to assess historic claims costs.
- Actual dates on risk are needed for this
- …and actual number of staff.
- We will need an estimate of projected number of staff over the policy period
- …grouped by risk band, or together with a relative risk factor.
- For example:
  - Dangerous job
  - Territory worked
  - Wage band
  - Age band
  - Other sensible grouping
- The exposure calculation will depend on whether the coverage is claims made or losses occurring.

Losses Occurring

- Prospective exposure is the estimated number of staff over the period.

Claims Made

- The prospective exposure should consider historic staff numbers as well as estimated future numbers
- …because new claims can arise from historic periods.
- Use a delay table to create a weighted average of them.
- Also is there a retroactive date?

Other factors to consider

- The number of staff may change throughout the policy period
- …or may move between risk groups.
- … so there needs to be a way of adjusting the premium retrospectively to allow for this.
- An adjustment may be needed for part-time staff.
- Consider data quality and data adequacy

This question was very poorly answered. The majority of candidates failed to read the question carefully, assuming that it required a repetition of bookwork on the characteristics of a good exposure measure in general. The question describes a specific class of insurance and a specific exposure measure, so the examiners were expecting points related to these. Comments on which exposure measure to use did not score.

2 (i)

- A type of reinsurance arrangement
- The fronting insurer underwrites a risk
- All (or nearly all) of the risk is ceded
- The fronting insurer will receive a fee or commission

- …to cover its expenses and profit.
- The size of the fee will take into account which party is carrying out administration and claims handling.
- In event of "reinsurer" default the liability falls upon the fronting insurer

(ii)

- Insurer may not have a licence for a particular class or territory
- …so can achieve diversification.
- Credit rating may be inadequate to satisfy the insured's minimum requirements.
- e.g. if the insurer suffered a downgrade just before renewal.
- There may be tax advantages in issuing the policy via the fronting insurer.
- The fee payable to cover the fronting insurer's expenses may be less than the expenses that would have been incurred in writing the business directly.
- Fronting insurer may have better underwriting expertise.
- Fronting insurer may be geographically closer to the market.
- The fronting insurer may have a stronger brand in the market.
- It is a way of dipping a toe into the market without a fuller commitment.
- There may be reciprocity opportunities between the insurers.
- The fronting insurer may have more advanced or more suitable administrative/business acquisition facilities.

Part (i) – This bookwork part was generally well-answered. Many candidates appeared to appreciate that fronting is effectively reinsurance, but failed to say so explicitly.

Part (ii) – This part was generally answered quite well, but candidates often focussed a little too much on tax and regulatory reasons, rather than commercial and practical considerations.

3 (i) Poisson : lambda = 4.8333

Negative binomial Type II:

Mean = $k\,(1 - p) / p$, Var = $k\,(1 - p) / p^2$

p = mean / var = 0.62231

k = mean^2 / (var – mean) = 7.96372

(ii) Negative Binomial as variance is much/considerably/significantly greater than mean.

(iii) Comments:

Historic exposure is needed
…and also projected future exposure.
Investigate whether the risks are similar enough to be pooled in this way.

Claim frequency needs developing to allow for reporting delays (or IBNR needs to be added).
Investigate whether the claim definition or treatment has changed over the years.
For example the treatment of zero claims.
Establish whether there has been a change in the external claims environment.
For example, litigation, regulation, behaviour, social.
Investigate what future claims trends are anticipated.
Investigate whether the policy coverage has changed.
For example, deductible levels.
Ascertain whether future coverage changes are expected.
Are more years of data available?
Is there relevant data available internally from similar products?
Is there relevant external data available?
Could consider a different method for fitting the parameters.
e.g. maximum likelihood or least squares or percentiles.
Or if a different distribution is appropriate
Carry out goodness of fit tests on the model.
Check for data errors.
Consider whether to change the weight given to older or newer years.
We would want to know what kind of business this is.
Specifically what type of distribution we would expect for this class.
Speak to relevant experts (eg underwriters) to get their opinion on the model and assumptions.

Part (i) – Some candidates equated the first moment correctly for the Poisson distribution, but then contradicted themselves by equating the variances to give a different answer. This approach scored zero.

Of the two parameterisations of the negative binomial distribution, only the Type II formulation is appropriate for modelling the number of claims because it allows for the possibility of zero claims in a year. A large number of candidates used the Type I formulation and scored zero.
Some candidates failed to give enough significant figures in their answer to score fully.

Part (ii) – Better-scoring candidates observed that the variance was greater than the mean, not just different, and that it was considerably so. Some candidates made unfounded statements about independence or dispersion of claims.

Part (iii) – This part required a wide range of ideas for a high score. Most candidates made the key points about the need for exposure data and developed claims. However, some answers contained a lot of detail about a narrow range of ideas, and others suggested claims severity models, which were not relevant (except for nil claims). Few candidates mentioned considering the type of business or consulting with underwriters or other experts.

4 (i) An arrangement under which the parties agree to share premiums and losses for specific insurance classes or types of cover in agreed proportions.

(ii) Both types of arrangement employ a degree of pooling of risks.
When insuring conventionally the insured's liability to an insurer is limited to the premium
…whereas in a pool the liability is related to the share of the total pool's claims and expenses.
Specific pooling is sometimes used where risks are very large.
For example, marine liability/atomic energy
or through associations that cater for an industry, such as P&I clubs
Certain costs may be lower, such as marketing and brokerage.
Members of the pool are more likely to share expertise than separate insureds.

(iii) **Calculating the trend rate for SI**

The difficult part of the trending is from policy years 2008 and 2009. Two methods, M1 and M2, are shown here, but other methods are possible.

Policy Year	*Inception*	*months @ 5%*	*infl factor*	*trend factors M1*	*M2 (average)*
2008	01-Nov-08	14	1.05857		1.0353
	01-Dec-08	13	1.05428		
	01-Jan-09	12	1.05000		
	01-Feb-09	11	1.04574		
	01-Mar-09	10	1.04150		
	01-Apr-09	9	1.03727		
	01-May-09	8	1.03306	1.03306	
	01-Jun-09	7	1.02887		
	01-Jul-09	6	1.02470		
	01-Aug-09	5	1.02054		
	01-Sep-09	4	1.01640		
	01-Oct-09	3	1.01227		
2009	01-Nov-09	2	1.00816		1.0010
	01-Dec-09	1	1.00407		
	01-Jan-10	0	1.00000		
	01-Feb-10	0	1.00000		
	01-Mar-10	0	1.00000		
	01-Apr-10	0	1.00000		
	01-May-10	0	1.00000	1.00000	
	01-Jun-10	0	1.00000		
	01-Jul-10	0	1.00000		
	01-Aug-10	0	1.00000		
	01-Sep-10	0	1.00000		
	01-Oct-10	0	1.00000		

We continue with M1.

Policy Year		*SI (£m)*	*Annualised SI (£m)*	*Annual Trend*	*Trend Factor*	*Trended SI*
2007	1 Nov – 1 Nov	25.1	25.1	5.0%	1.08471	27.2
2008	1 Nov – 1 Nov	26.0	26.0	3.3%	1.03306	26.9
2009	1 Nov – 1 Nov	29.8	29.8	0.0%	1.00000	29.8
2010	1 Nov – 1 Nov	33.2	33.2	0.0%	1.00000	33.2
2011	1 Nov – 1 Aug	25.6	34.1	0.0%	1.00000	34.1

Selection of 2012 trended SI: for example, 35.0

Assumptions:

- SI is written evenly throughout the policy year (or other sensible assumption, provided calculations are consistent).
- SI is at midpoint of year for inflation purposes.
- SI is a good exposure measure.
- Inflation remains at zero.

Developing Claims

PY	*Month*	*% Dev*	
2007	57	94%	(9*0.95+3*0.9)/12
2008	45	85%	(9*0.9+3*0.7)/12
2009	33	63%	(9*0.7+3*0.4)/12
2010	21	35%	(9*0.4+3*0.2)/12
2011	9	15%	(9*0.2)/12

Policy Year	*Exposure (1)*	*Number (2)*	*% Dev (3)*	*Developed (4)=(2)/(3)*
2007	27.2	203	94%	216.5
2008	26.9	129	85%	151.8
2009	29.8	179	63%	286.4
2010	33.2	30	35%	85.7
2011	34.1	50	15%	333.3
2012	35.0			

Selection of 2012 claims

Policy Year	***Selected/ Exp. (5)***
2007	8.0
2008	5.7
2009	9.6
2010	2.6
2011	9.8
2012	

Claims/Exp	
simple average	7.1
weighted average	7.1
simple (07–11)	6.4
Select	6.4
2012 Exp	35.0
2012 Number	225.7

Justification:

- The more recent data is more representative.
- Older claims data are more certain (no IBNR).
- But exposure is less certain, due to trend assumptions.
- Generally put more weight to recent data but try to understand shift.
- Latest year is very uncertain due to large development.
- 2010 may be anomalous, so could put less weight on this.
- No explicit additional allowance for large claim/cat experience in needed.
- Completely experience-rated (past is a good guide to future).

Part (i) – Candidates often gave quite loose definitions for this part, referring to the concept of insurers grouping large numbers of risks together to reduce the variance, rather than the specific definition for ST8.

Part (ii) – Many students were unclear about the differences from conventional insurance, with most only referring to profit as an issue. Stronger candidates mentioned similarities.

Part (iii) – This part was generally well-answered, albeit with a range of approaches. Credit was given for any sensible variants to the method shown above, particularly when the calculations were backed up by justifying assumptions. Weaker candidates used a method that contradicted information given in the question; for example, applying the development factors as if based on months since the midpoint of the policy year.
Adjustments for sum insured were often over-simplified. However where the deviation from the method above was slight and the assumptions given were consistent, full credit was awarded.

Other common shortcomings were:

- *Failure to interpolate the development factors to obtain the correct number of months of development.*
- *Failure to adjust the 2011 exposure to a complete year.*
- *Not giving enough points on assumptions (few students made comments on whether or not to include 2010 or 2011).*

5 (i) Assumptions:

- There exists a latent parameter θ_i such that:
  - $E(X_{ik} \mid \theta_i) = \mu(\theta_i)$ for all k
  - $\text{Var}(X_{ik} \mid \theta_i) = \sigma^2(\theta_i) / V_{ik}$ for all k
- The ith risk is described by the pair $(\theta_i, (X_{ik})_{k\geq 1})$, where $(X_{ik})_{k\geq 1}$ is the sequence of claims per unit turnover observed for risk i in years k .
- The pairs $(\theta_i, (X_{ik})_{k\geq 1})$ are mutually independent.
- The θ_i are independent and identically distributed.
- Conditionally on θ_i, the X_{ik} 's are independent.
- …but not necessarily identically distributed.

Let:

- $\hat{\beta} = E(\mu(\theta_i))$ *(benchmark claims per unit turnover)*
- $\hat{\varphi} = E(\sigma^2(\theta_i))$ *(expected variance of the observed claims per unit turnover)*.
- $\hat{\lambda} = \text{var}(\mu(\theta_i))$ *(variance of the long-run claims per unit turnover for all risks)*.

We estimate the ultimate loss per unit turnover, $\mu(\theta_i)$ as $z_i \overline{X}_i + (1 - z_i)\hat{\beta}$

Where $z_i = V_i / \left(V_i + \hat{\varphi} \middle/ \hat{\lambda}\right)$

(ii) Workings below are shown to at least 6 significant figures throughout.

$N_1 = 5$

$N_2 = 2$

$R = 2$

$\hat{\varphi} = (2{,}297{,}024 + 30{,}388) / (5 - 1 + 2 - 1)$

$= 465{,}482$

$V_1 = 5033 + \ldots + 6368 = 28{,}202$

$V_2 = 6623 + 6888 = 13{,}511$

$V_1\left(\bar{X}_1 - \bar{X}\right)^2 = 28202\ (23.4692 - 27.6994)^2$
$= 504{,}663$

$V_2\left(\bar{X}_2 - \bar{X}\right)^2 = 13511\ (36.5294 - 27.6994)^2$
$= 1{,}053{,}438$

$V = 28202 + 13511 = 41{,}713$
$\hat{\lambda} = (504663 + 1053438 - 465482) / (41713 - (28202^2 + 13511^2) / 41713)$
$= 1092619 / 18269.5$
$= 59.8056$

$z_2 = 13511 / (13511 + 465482 / 59.8056)$
$= 13511 / 21294.3$
$= 0.634489$

Risk 2 claims per £000 turnover
$= (0.634489)(36.5294) + (1 - 0.634489)(27.6994)$
$= 33.3020$

So expected losses in 2011 for Risk 2 are $(33.3020)(9000)$
= £299,720 (to 5sf)

Part (i) – This bookwork part was well-answered by those candidates who had learned the theory and hardly attempted by those who had not. Credit was still given where some of the subscripts were omitted.

Part (ii) – This part offered plenty of scope for candidates to demonstrate clear and methodical workings. Candidates who did so gained marks for the majority of their attempt, despite any numerical errors. This gave them a clear advantage over candidates who did not show sufficient workings because calculation mistakes were so common in this part.
A common error was using V, *rather than* V_2, *in the calculation of* z_2.

6 (i)

- Surveyor's report
- Type of trade or business
- Type of use of building
- Dangerous materials/processes
- Value of cash stored on premises
- Known mine workings or similar underground hazard
- Part of building unoccupied
- Age of building
- Time since last renovation
- Construction type
- Location of building/postcode
- Floor area
- Section-level limit: rebuild SI

- Section-level limit: value of contents SI
- Overall policy limit
- Excess/deductible
- Fire protection equipment e.g. sprinklers
- Security features
- Value of property
- Number of properties in the policy size – may get a size credit
- Exclusions
- EML/PML
- Period of cover
- Coverage e.g. BI included, flood, subsidence, terrorism
- Number of floors in building
- Distance from hazard, eg coast or river
- Height above sea level
- Loss history/claims experience

(ii) Exposure/policy details

- Rating factors
- History of changes to rating factors
- Particularly, rating factors at time of claim
- Policy dates/period on risk

Claims details

- Claim reference
- Link to policy
- Risk identifier (if the policy covers multiple properties)
- Claim status – open/closed
- Claim dates:
  - Incurred
  - Reported
  - Settled
  - of payments
- Definition of claim amount, ie ground up or after deductible
- Payment type
- e.g. indemnity, loss adjuster fee
- Amount of payment
- Estimated amount outstanding
- Date of estimate of outstanding amount
- Basis of estimate
- Recovery amount
- Policy section/type of claim
- eg stock
- Type of peril
- e.g. flood, fire

General

- Currency of values

(iii) **Data**

- Either set of data may be unrepresentative of the business written.
- e.g. the broker may seek out riskier business (or other example).
- The claims data underlying either rate might not have been fully developed.
- Either data set may not be large enough to give a significant result.
- The underwriter's rate may have a significant element of judgement or subjectivity.
- For a valid comparison we need to compare on a standardised coverage.
- For example flood may be in the analyst's rates, but in the underwriter rates it may be excluded and adjusted in a rating factor (or other example).
- The analyst's data might be missing catastrophe experience.
- Either set of data may be out of date.
- There may be errors in either data set.
- There may be a difference in the definition of "office".

Method/basis

- There may be a model or calculation error in either rate.
- Underlying assumptions may be different between the two rates.
- e.g. future claims trends, inflation (or other valid example).
- Different rating factors may have been used.
- The stated rates may be percentages of different things.
- Eg: sum insured, EML.
- Losses aren't the only contribution to the base rate.
- Differences may occur to differences in assumptions for:
  - Cost of reinsurance
  - Commission
  - Expenses
  - Cost of capital
  - Profit
  - Investment income
- The underwriter's rate may have taken into account market/competition considerations/place in underwriting cycle.
- Either rate may cross-subsidise/be cross-subsidised by another occupancy class.
- Regulations may have restricted the underwriter's rate.

Part (i) – Very few candidates mentioned a surveyor's report, and some gave rating factors more suitable for business interruption cover (turnover), employers' liability (first aid training) or domestic house insurance (locks on windows).

Part (ii) – In general, this part was answered fairly well. However, many candidates revealed misconceptions about the data that insurers store on their databases, mentioning items such as inflation rates and underwriters' views. Many candidates also wasted valuable time writing exactly the same rating factors they had just given in Part (i).

Part (iii) – In this part, higher-scoring candidates considered a wide range of issues, rather than focusing too much on the analyst's viewpoint and possible model error. Some students

commented that the difference in base rates is not large enough to be significant, even though the underwriter's rate is 40% higher than the analyst's.

7 (i) The company would ideally want to be put back in the same financial position as it would have been, had the tour not been cancelled.

The reinstatment of lost profits could include elements of the following:
Cost of refunding entry fees …
… including possibly the associated postage or bank transaction costs.
Other lost income, such as:
Sponsorship from companies advertising at the event.
Commission from accommodation or sales at the event.

Legal expenses incurred in resolving disputes.

WWW may also want to be reimbursed for other outlays associated with the event for which they would be unable to get a refund upon late cancellation.

For example,

- costs of hiring buildings or other equipment (e.g. at the start or end of the event)
- costs of providing accommodation/subsistence, if included in the booking
- costs of hiring staff to run the event
- advertising
- printing

(ii) It would collect any available data from WWW:
such as the number of participants in similar events ...
... or in the same event held in previous years.
Details of dates & locations of past events.
Number of events that have been cancelled in the past.
Profit generated from previous tours.
Expenditure on such events in the past.

It will also need to know the entry fee for each future event from WWW.

It could investigate if there is any relevant external data available,
Perhaps from the broker or a reinsurer (or other feasible source)
although this is unlikely to be the case because the risks are heterogeneous and this type of insurance is not widely written.

It may need to consult with experts (scientists, meteorological office etc.)
because the weather will be difficult to predict.
Or it might obtain data from a specialist data provider/bureau.

It could contact cycling organisations to see if there is any historic information on events and cancellations.

Cat models (since the risk comes from the weather).

Other weather-related insurance covers that the syndicate has written.
Look at other event cancellations as a proxy – perhaps fun-runs?

(iii) **General points**

It may want to price each individual event separately…
… to take account of the expected weather conditions.

or it may set a price to cover the whole season,
up to a specified number of events and entrants.

The amount of cover will be related to the number of events.
and the size/scale of the event i.e. the number of participants and the entry fee.

Risk premium

Rating factors – look at similar adverse weather policies (e.g. pluvius insurance), written by other companies or syndicates, to see what types of rating factors are used (if any).

Look at any previous claims experience from this syndicate.
Adjust the experience to the projected period of exposure.

It will need to consider frequency and severity separately.
…because they are influenced by different factors.

Frequency

It needs to consider likely weather patterns for the date(s) of the event(s), and the likelihood of the weather being severe enough to cause a problem.

In order to arrive at this, it can use a blend of relevant experience and judgement.

Relevant experience could come from weather-related data.

The judgment element may require help from relevant experts e.g. weather scientists.

This will be very difficult to predict.
and so may be covered by a contingency margin (implicit or explicit) rather than a specific loading to the premium.

It may need to take into account the non-independence of weather events from one day to the next …
… for example, if a flood occurs then it might clear up in a couple of days whereas a freeze event could last for weeks.

Severity

This will depend on the amount of cover provided.
e.g. maximum limits, excesses, exclusions (*or other example*)

- likely to be determined by the expected number of events × average expected number of participants x the known entry fee
- plus loadings to cover additional lost revenue
- or based on expenses incurred
- or on historic profit per event

We should allow for seasonality e.g. not as any participants during the winter months (or other sensible example)

We can ignore discounting because this is short-tailed business.

Other loadings

Expenses
– consider the likely marginal costs associated with writing this business, especially the additional costs of consulting with weather experts for each event
and an allowance for contribution to overheads.

Commission
– as this will be sold via the Lloyd's broker that approached us.

Profit (and contingencies)
– there is a lot on uncertainty attached to pricing this business so we might want relatively high profit loadings.
Adjust as necessary to reflect any existing relationship with the broker or insured (or cross-selling opportunity).

Competition – if there are any other insurers writing this business, or quoting for this particular contract then we would need to take account of their rates.

Reinsurance – any costs of including this class within the reinsurance cover.

Capital charge to reflect cost/availability of capital ...
… and accumulation/diversification with other UK weather risks in the portfolio e.g. property insurance.
Allow for investment income, if any.
Allow for any premium levies.
Add any premium tax.

Allow for any element of experience rating in the policy.
Allow for an adjustment premium to reflect a different number of entrants from that assumed.

(iv)

- Apply an excess
- …to reduce all claims
- …and eliminate small claims
- Apply an aggregate deductible if cover is multi-event.
- Impose an upper limit on the cover
- …to reduce large claims
- …either per event or overall
- Require WWW to participate in the risk e.g. by making them cover a % of the cost (participation clause)
- Or introduce an element of experience rating
- …to ensure that WWW doesn't cancel events unnecessarily (/reduce moral hazard).
- Require WWW to have an adequate level of contingency planning e.g. an alternative route in case a specific road is closed due to flooding.
- Require WWW to limit losses by using contract wording with entrants & suppliers.
- Require WWW to insure all events rather than selecting certain ones, to minimise the claims costs per tour and avoid anti-selection.
- Be very clear on the definition of how intense a weather event has to be before the insurance will become payable.
- e.g. at least 2 inches of rain in the preceding 24 hours along any part of the course.
- Require WWW to attempt to reschedule events.
- Require WWW to vet entrants' claims for possible fraud.
- Exclude some perils or risks.
- Restrict location (e.g. not in very wet or snowy places).
- Restrict the dates of events covered (eg midwinter).

Part (i) – Most candidates were able to generate the main points. However, many suggested that the product would cover the cost of rescheduling events and physical damage done to equipment or property by bad weather, neither of which is appropriate.

Part (ii) – This part was answered well, but very few candidates mentioned getting any data from the insured.

Part (iii) – Candidates tended to produce generic answers, rather than attempting to deal with the specific situation. The better answers considered the entire pricing basis, and for claims experience how the frequency (likelihood) and severity of claims could be more accurately quantified in the face of considerable uncertainty. In contrast, many candidates provided excessive detail on minor aspects of the solution, such as discussing in depth the types of model that would be used for claims, such as GLMs. The main problem here was that many candidates appeared to think that the risk could be largely experience rated, or that there was plenty of stable historical data available, both of which are very unlikely.

Part (iv) – This part was generally answered well, with most candidates giving a good range of points.

8 (i) Vehicle-years or policy years.
Level of risk is reasonably proportional to it
Easy to quantify/known at the start of the policy
Objective/can't be manipulated
Easily verified from policy records
Acceptable to policyholder, legislators, regulators.

Alternative answer (not additional)
Vehicle-miles
Level of risk is reasonably proportional to it
Can be verified, but needs an independent party or reliable equipment
Acceptable to policyholder, legislators, regulators.

(ii) Frequency: relatively high ...
... although there may be limits on how many callouts are allowed in any year.

Seasonality would be expected
(more breakdowns in extreme temperatures or at very busy times on the roads)

Moral hazard element because insured may try to buy cover knowing the vehicle is in poor condition.
Moral hazard element because the insured may fail to minimise losses once the insurance is in place (eg running the fuel tank very low)

Geographical variations from differences in traffic/road conditions.

Accumulations possible from weather or other events.
There may be trends over time, as vehicle types or usage patterns change.

Reporting delays – very short.
Breakdowns are generally reported very quickly because losses usually arise from incidents that are observed at the time.

Settlement delays – (very) short.
The value of the loss is usually straightforward to establish and claims are usually dealt with very quickly.
may be exceptions, eg dispute over coverage if breakdown occurs near home.

Claims amounts – relatively low compared with most other classes.
Amounts not very volatile
Inflation will be linked to mechanic's wages.
also fuel costs and value of cars and car parts.
There may be nil claims for events not covered by the policy (eg wilful damage).

Some currency effects where foreign travel is involved.

(iii) (a) Frequency – Poisson
Severity – Gamma
Marks were given for other sensible frequency and severity distributions e.g. negative binomial, lognormal, Pareto, Weibull.

(b) *Take care that the correct terminology is used here*
Frequency – number of exposures *(credit if actual exposure measure given)*
Severity – number of claims

(iv) It might be the case that older cars do fewer miles each year so there will not be as many cars in this combination in the overall population.

Existing / previous breakdown cover might have excluded old or high mileage cars.
Or the rates may have penalised older cars with higher mileage (compared to the competition) so we may have written fewer policies here.

Either because the rates are high for older cars or for high mileage cars or for the combination.

The breakdown cover might have previously been marketed mainly at newer cars.
e.g. sold by motor manufacturers at the point of sale of a new car.

There may be fewer older cars in the overall population.
e.g. due to government incentives to buy new cars.

If breakdown insurance is written only as an add-on to motor insurance and the underlying motor rates are uncompetitive for this combination (e.g. because it's not the part of the market we're targeting) then there won't be many cars in this combination that are eligible for the breakdown insurance.

There could be an error in the data e.g. if it hasn't picked up all the cells.

It may be the case that people with older cars more likely to understate the mileage.

(v) Assume that the relativities given are exact i.e. there is no random variation and/or they are truly representative of the risk.

Car Age	*Mileage*	*Exposure*	*Predicted Value*	*Total Response*
0 – 1	0 – 8,000	900	0.40	360
0 – 1	8,001+	25,450	0.80	20,360
2 – 6	0 – 8,000	4,700	0.50	2,350
2 – 6	8,001+	13,025	1.00	13,025
7 +	0 – 8,000	5,273	1.50	7909.5
7 +	8,001+	652	3.00	1956

One-Way Tables

Car Age	*Total Exposure*	*Total Response*	*Predicted Value*
0 – 1	26,350	20,720	0.79
2 – 6	17,725	15,375	0.87
7 +	5,925	9,865.5	1.67

Mileage	*Total Exposure*	*Total Response*	*Predicted Value*
0 – 8,000	10,873	10,619.5	0.98
8,001+	39,127	35,341	0.90

(vi) **One-way table for Car Age**

The ratio of predicted values (re-basing 2 – 6 to be 1.0) is: 0.91 : 1 : 1.92
This understates the true relativities of 0.8 : 1 : 3.0

because the good experience for young cars (0 – 1) is masked by the higher mileage done by these cars

(equivalently) because the poor experience for older (7+) cars is masked by the lower mileage done by them.

One-way table for Mileage

The ratio of predicted values (re-basing 8,001+ to be 1.0) is 1.09 : 1

This gives very misleading results compared with the true relativity of 0.5:1 1

because most of the vehicles with low mileage are older (i.e. the good experience for low mileage is masked by the older age of these vehicles)

(equivalently) because the vehicles with high mileage tend to be newer (i.e. the worse experience for high mileage vehicles is masked by the fact that this mostly relates to new cars).

General

A GLM will unpick these relationships and therefore produce estimates of the true values of the relativities.
The GLM can also be extended by adding an interaction term if this is significant.

Part (i) – This part was generally answered well, although some candidates suggested an exposure measure based on the age of vehicles, which would not be appropriate.

Part (ii) – This part was generally answered well, but some students used imprecise terms, such as "claims are short-tailed" or "claims are positively skewed", which could not be given credit.

Part (iii) – This part prompted a range of answers, many of which showed a lack of understanding. Answers for (a) were generally correct, but some candidates suggested the Normal distribution for severity, even though negative claim amounts are unlikely. Many candidates appeared not to understand the meaning of "prior weight" in (b).

Part (iv) – This part was answered quite well, particularly where candidates came up with a range of different points. Candidates scored less well where they focused on reasons why there would be few old cars covering high mileages on the roads, or reasons why there would not be many old cars on the roads (ignoring the mileage aspect of the question).

Part (v) – Answers to this part were very variable. A large number of candidates were unable to identify the correct calculation to perform, but those who found the right method had little difficulty in scoring full marks. Some candidates lost marks by not performing intermediate calculations with sufficient precision for an answer to two decimal places, or not showing workings clearly enough.

Part (vi) – Most candidates were able to make relevant points in this part, but answers were generally not very thorough. High-scoring candidates justified their answers with evidence from Part (v), rather than relying on generic statements about the benefit of GLMs. Full credit was given for observations that were consistent with the results from Part (v), even where those results were calculated incorrectly.

END OF EXAMINERS' REPORT