INSTITUTE AND FACULTY OF ACTUARIES

EXAMINERS' REPORT

April 2015 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.

The report is written based on the legislative and regulatory context pertaining to the date that the examination was set. Candidates should take into account the possibility that circumstances may have changed if using these reports for revision.

F Layton
Chair of the Board of Examiners

July 2015

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 April 2015 Paper

The level of difficulty of the paper and the general performance of candidates were similar to recent sittings. There was no evidence of time pressure in this paper around the pass mark area.

Yet again, a number of candidates displayed poor handwriting at this sitting, which made it difficult for examiners to award full credit. Candidates who struggle with the legibility of their handwriting are asked to contact the Examinations Team well in advance of the sitting for advice on what support may be available.

Whilst candidates were tested on various aspects of the bookwork, it would have been difficult to pass this paper without displaying a good ability to apply the syllabus to problems posed. Candidates should take care to explain fully the points they are making, and to make sure they are answering the question that is being asked.

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 Claim types may be miscoded (e.g. escape of water miscoded as flood)

Date of loss may be wrong (possibly unknown or recorded as date of notification)

Development patterns change:
e.g.
> Naturally over time;
> Political pressures to settle quickly following disasters;
> Or delays in settlement due to staff shortages;
> Or changes in claims handling processes;
> Other valid example

Impact of claims initiatives the company has implemented will affect trends.

Inherent uncertainty in the timing and amount of individual claims.

Uncertainty in treatment of catastrophes or large losses.

Demand surge, following a catastrophe, may cause cost to change in an unpredictable way.

Inflation changes over time,

and different elements of claim will be affected by different rates of inflation.

Legislation and/or court awards may also impact the timing and amount of claims.

Impact of changes in case estimate reserving philosophy.

Impact of changes in the mix of business.

Impact of changes in policy terms and conditions (e.g. excess or limits) and/or strictness of underwriting over time.

Uncertainty arising from the data:

> Lack of sufficient volume
> Data is not detailed enough
> May not be reliable, e.g. if received from a broker

Unusually light/heavy experience

Changes in reinsurance conditions

Impact of changes in third party behaviour e.g. claims farming

Potential for latent claims

Changes in economic conditions and/or currency movements

Changes in distribution channels or relationship with distributors

Climate changes / global warming

Incorrect assumption of case closure.

Generally well answered, but a large proportion of candidates didn't generate enough points to gain full marks. Some candidates were also unclear in their answers, e.g. by writing "economy" rather than "changes in economic conditions".

2   Household business is exposed to natural catastrophes which vary by the seasons.

As a household policy is for 12 months, a six month analysis period would not capture all likely experience.

Many risks have a return period much longer than six months, even longer than 12 months (e.g. subsidence), thus an analysis period of several years is likely to be necessary.

It would not be possible, for long-tailed claims such as liability, to derive appropriate development patterns to project claims to ultimate

A short analysis period is unlikely to be very credible – the experience may have been unusually heavy or light.

There is little consistency between the exposure data and the claims data that the data warehouse manager is proposing to give

Although household business is relatively short-tailed, the most recent claims will be largely case estimates, and all will be under-developed.

Therefore the observed incurred development pattern in the data may relate more to the claims reserving philosophy of the insurer in question than to the true underlying claims process.

The volume of claims is likely to be low and the lack of payment development history will make any projections to ultimate flawed.

Reinsurers/regulators/auditors are likely to view this negatively

Would make it difficult to monitor performance and mix of business

May force the insurance company to use external third party data which may not be relevant or cheap

The limited claims history will also make trend spotting particularly difficult.

With six months' claims and exposure, after sub-dividing the data into separate perils and then into homogeneous rating cells, there is unlikely to be sufficient data for credible statistical analysis.

Some candidates spent time discussing the advantages of the proposed plan, though the question explicitly asked only about the problems. Most correctly identified that the exposure data and claims data would be inconsistent, which was the core point.

3 (i) The distribution combines claim frequency and claim amount into one distribution, i.e. it allows us to model the pure premium (or aggregate claims) directly.

This avoids the need to model them separately.

The Tweedie distribution is a member of the exponential family, which means that it is amenable to use in a GLM

The distribution of claims will be likely to have a point mass at zero…

…representing policies that have had no claims,

…then a wide range of positive claim amounts.

The Tweedie distribution has a point mass at zero, and so takes this shape.

Fitting GLMs separately to frequency and severity experience can provide a better understanding of the way in which factors affect the cost of claims.

This more easily allows the identification and removal (via smoothing) of certain random effects from one element of the experience.

(ii)

	Link Function	*Error Structure*	*Prior Weights*
Claim Frequency	Log	Poisson	Exposure or policy years
Average Claim Amount	Log	Gamma	Number of Claims
Probability of Renewing	Logit, i.e. $\ln(y/1-y)$	Binomial	1

Generally answered well, though some candidates seemed unfamiliar with the Tweedie distribution. A common error was to say that the point mass at zero in the distribution was in respect of nil claims, rather than policies with no claims Many did not generate enough

points in part (i) to score full marks; and a large number struggled with the prior weights in part (ii).

4   Cover types…

e.g. hull damage, theft, liability etc.

Primary excesses, limits, exclusions, changes in cover

Number of seaplanes to be insured

Total value of seaplanes, and/or cost of repairs

Types and/or size of seaplanes (therefore giving information about number of seats/numbers of passengers, fuel type)

Whether the hulls are to be insured on an agreed value basis (as opposed to market value)

Whether aircraft are hangared when not in use

Whether aircraft are owned or leased

Territories in which they operate and/or location of fleet

Whether they operate on enclosed bodies of water only, or on open seas

Past claims experience …

… such as dates of loss, causes, amounts, currency

Licensing requirements for pilots, or minimum number of flying hours

Experience of current pilots, including certificates and ratings held

Whether they are available for hire

Amount of use of aircraft (historic and proposed), by plane

What the planes are used for (passenger/cargo/mixed)

If they transport cargo, the type and value of the cargo

How regularly the seaplanes are inspected/serviced, or the time since last service

Age of seaplanes or their expected lengths of service

Whether they operate all year round, or seasonal

Safety features in the planes

Whether the planes can also land on ground as risks are different to open water

Proposed dates of cover

Need past exposure (risks and dates on cover) to go with claims …

… possible measures of exposure are plane years or air miles travelled

The main reasons for candidates not gaining high marks in this question were an inability to give points specific to this product, and not answering the question. The question asks for information about the fleet, however a lot of candidates suggested details about the product structure (e.g. attachment points), and other points not relevant to the fleet.

5   (i)   (a)   Direct expenses are those we can allocate accurately to individual policies/lines of business,

whether new business acquisition or administration of business on the books

Examples include
  policy documentation
  call centre staffing costs
  commission
  claims handling expense
  other suitable distinct examples

(b)   Indirect expenses are all other expenses, relating to general management and service departments,

not directly involved in new business acquisition or policy maintenance activities

and are insensitive in the short term to either the volume of new business or the level of business on the books.

Examples include
  any property related costs (rent, heating, power etc.)
  staff costs for central services departments (e.g. reserving)
  other suitable examples

(ii)   The company will need to understand how expenses are split between:

New business commission
Other new business costs

        Administration
        Renewal commission
        Other renewal costs
        Claims handling
        Investments

As these are usually proportional to some measure of volume, the company will need information about:

        new business volumes (policies and/or premium)
        renewals volumes (policies and/or premium)
        number of mid-term adjustments
        claims volumes and/or costs

both in the past and expected in the future

The expenses will also have to be split between:

        Lines of business
        Source – internet or call centre
        Office – different locations will have different costs

Therefore, the volumes should be split by these factors.

To allocate staffing costs, the actuary will need to know how each member of staff's time is spent (however this is likely to be summarised at department level)

Property/accommodation charges are likely to be split by headcount or floorspace

Future changes in staffing levels and accommodation need to be taken into consideration.

Computer costs will be apportioned according to usage.

Information about one-off costs will also be required

Part (i) was generally answered well. Answers to part (ii) tended to be poorly structured; some candidates went into detail on the different types of expenses. Few gave clear answers about what information would be needed to allocate expenses.

6   (i)   Starting from a point where insurance is generally highly profitable – known as a hard market.

           The level of profitability attracts new entrants …

           … and encourages existing insurers to write more business.

To fill the extra capacity and/or remain competitive, premium rates are reduced to attract business.

Premium rates continue to fall to the extent that the business is generally loss-making – known as a soft market.

Insurers leave the market in response to the level of losses, …

… or write less business.

With restricted availability of insurance and/or reduced competition, premium rates increase.

Eventually premium rates increase to the extent that insurance is generally highly profitable again.

(ii)   This would intensify the underwriting cycle

In a soft market, policies will generally be underpriced …

… however, the capital required to write this business will be less (because it's low premium)

As capital requirements are reduced, premium levels will get reduced further, making premiums even less profitable.

This exacerbates the downward path of the underwriting cycle.

Conversely, in a hardening market, insurers will require more capital to write business which is more profitable (over priced).

This will reduce entry to the market and/or existing insurers will exit, and may also limit the amount of business that may be written.

This will push premiums up even more as demand outstrips supply.

(iii)   <u>In a hard market:</u>
All else being equal, the insurer will quote cheaper premiums than the rest of the market.

The insurer will tend to attract more business as a result.

This could put a lot of new business/capital strain on the insurer.

Competition will recognise the need to soften their rates and stop writing excessive profits.

The insurer's market share will be compromised as competition start quoting significantly reduced rates.

In a soft market:
All else being equal, the insurer will struggle to sell any business as its premiums will be the most expensive in the market.

The insurer may struggle to meet its overheads …

… and be forced to exit the market and/or face regulatory intervention.

In general
The insurer will feel the effects of the insurance cycle more quickly than others in the market, …

… and to a greater degree.

Part (i) was generally answered well, though many candidates didn't seem to appreciate the underwriting cycle can also be driven by existing firms expanding and contracting, rather than just by insurers entering or withdrawing from the market. Part (ii) was generally poorly answered; many failed to come to a clear conclusion, and those that did often came to the wrong conclusion. In part (iii), most candidates incorrectly said that the insurer would necessarily face anti-selection, and many seemed to equate pricing out of line with the market with mis-pricing.

7   (i)   There may have been a general review of risk premiums :
e.g.

new claims frequency/severity models or risk premium model
inflation
movement in trends
revisions to rating area allocation or car group
other suitable distinct examples

The new business premium may include an introductory discount

Although there's no NCD, insured's claims history might be part of the risk model

Changes in expenses, capital charge, RI, company tax, premium tax etc.

There may have been changes in cover (different excesses, added an additional driver)

There may have been changes in the risk (larger car, moved house etc.)

Price increases may have been capped at renewal (e.g. 10% rise)

Could reflect a general hardening/softening of rates in the market

There may be regulatory restrictions on price movements

There could be errors in the calculation process

There may have been changes in legislation which impact the premium (e.g. gender neutral pricing)

The company may be taking account of price elasticity/inertia pricing

Retrospective rating may be being used such as Pay As You Drive

The different prices may reflect the company's changing strategy and/or target market

The customer may have received some discretionary discounts, depending on the company's retention strategy

(ii)   <u>Initially agree on operation of NCD</u>
The insurance company must decide how many levels of no claims discount (NCD) it wants to operate,

…what the rules are for new entrants

…and what the rules are for moving up and down the scale (e.g. move up at most one for each claim-free year)

Which types of claim are allowable, i.e. don't result in loss of NCD levels (e.g. non-fault or windscreen)

It may also want to consider whether to allow customers to protect NCD, and how this might operate.

These choices may to some extent be driven by existing market practice …and regulatory restrictions

But it should determine the optimal theoretical structure and possibly be prepared to compromise it, after doing impact analysis

The scale and how it operates should also be agreed with the marketing team

<u>Model historic experience</u>
The insurance company should take some historical exposure and claims data, and determine the NCD for these risks over time.

The insurance company can model the claims experience, using NCD as an explanatory factor in a GLM to determine the discount appropriate at each level.

The results of this may mean revision to the planned scale and rules required, …and the model should be re-fitted.

Review and implement
The insurance company should ensure that the level of discount offered and the operation of the NCD system is acceptable to existing and/or future customers.

The insurance company should consider the impact of the new NCD system on customer behaviour (e.g. elimination of smaller claims) caused by bonus hunger, …

which may also lead to a reduction in claims handling expenses.

Having agreed, across the business, the operation of NCD and the scale, it should be fitted as an offset term in the GLM.

Thus allowing the other factors to absorb the difference between the theoretical and chosen NCD scale.

Many candidates did well on part (i); but many struggled to generate enough distinct points. In part (ii), many answers lacked details on specifics of how an NCD scheme works. Very few candidates covered the practical process of agreeing an initial NCD scale to begin with.

8   Overall observations
The figure of £683,330 is much higher than the expected loss costs for Borg alone…

…i.e. £18,227.

This could make the premium very uncompetitive.

Practicality
Data is readily available

Simple/quick to calculate (low chance of error)

Calculation method is easy to explain/understand

The complementary risks have a logical relationship to the loss costs of Borg, which makes the approach justifiable.

Metrics used
EML might be a better measure of risk level (exposure) than sum insured.

Frequency and severity are treated the same and combined into one calculation, which might not be the most appropriate.

Analysing frequency and severity separately would better allow for trends affecting one or the other

BI cover levels for Klingon and Romulan are very different from Borg's, so the loss experience may need adjustment.

Credibility factors
The method assigns 25% credibility to Borg's experience and 75% to the other risks (or 25% credibility to each risk).

This seems quite arbitrary, with no obvious evidence to support it.

Use of several different risks should, in theory, help to stabilise the estimates.

However, lower weightings should be used for the risks with more volatile loss experience.

Suitable weights would be the SI

Relevance
It is appropriate to include Borg's own recent loss history because it is the most relevant.

Vulcan appears relevant…

…given its large size / multiple warehouses / similar cover level.

However, its loss experience is high volume and low value, so the risk characteristics may be different…

…and there is only one year of experience to go on.

So perhaps Vulcan should have a lower weighting.

Klingon and Romulan appear less relevant…

…because they are much smaller / have different BI cover levels.

So, perhaps Klingon and Romulan should also have lower weightings.

Also because Klingon and Romulan experience data is older and possibly less relevant today

It might not be appropriate to use the experience of Klingon, Romulan and Vulcan at all if the nature of the risk is very different.

e.g. due to materials stored, protective measures, natural hazards.

The sites closer to Borg may be more similar, or exposed to similar risks and therefore would deserve a higher weighting than those less close

Independence
Klingon may not be sufficiently independent from Borg…

…because of its proximity.

If so, it should be given a lower credibility weighting.

Other considerations
There appears to be no explicit consideration/expectation of unusual experience (large claims).

The losses per unit SI are swamped by Klingon's experience.

This is amplified when the losses are scaled up to Borg's very large sum insured.

It is probably appropriate to take a smaller proportion of this unusual experience (or truncate it/spread it out more, or use a lower or even zero credibility weighting).

A loading/allowance for catastophes, such as flood should be added

A more theoretically sound approach, such as Empirical Bayes Credibility Theory, could also be tried

Most candidates focussed on the obvious problems with the proposal, without recognising any advantages. The higher scoring candidates recognised that the proposal had merit, but needed to be refined. Most correctly identified the differences between the warehousing sites, but a number gave no detail on more general problems with the proposal (e.g. the need for frequency-severity modelling, large loss and catastrophe loadings), and thus scored relatively poorly.

9 (i) Advantages
It enables an insurer to write larger risks, which might otherwise be beyond its writing capacity.

It enables the insurer to choose, within limits, the size of risks that it will retain.

Can choose to cede which risks you want, which isn't possible with obligatory QS

It is better for those classes where a wide variation can occur in the size of risks.

As a result of all of the above, it can help the cedant to achieve a better portfolio balance.

Disadvantages
The administration is more complicated than for quota share…

…owing to the need to assess and record separately for each risk the amount to be ceded.

This makes it unsuitable for mass-market personal lines…

…since the size of risks is too small to merit individual attention.

The choice of reinsurers or terms offered may not be as favourable as QS…

...because of the possible anti-selection risk borne by the reinsurer.

If the facility is facultative-obligatory, the direct writer may forget to cede a large risk.

(ii)

Risk	EML ($)	Retention ($)	Lines of cover used	Ceded %	Gross premium ($)	Ceded premium ($)
1	5,000,000	1,000,000	A = 4	80%	34,800	B = 27,840
2	10,000,000	800,000	C = 5	40%	68,000	D = 27,200

(iii)

Risk	Ceded %	Gross premium ($)	Ceded premium ($)	Gross loss ($)	Ceded loss ($)
1	80%	34,800	27,840	15,000	12,000
2	40%	68,000	27,200	18,000	7,200
Total		**102,800**	**55,040**	**33,000**	**19,200**

Gross loss ratio = 33,000 / 102,800 = 32.1%
Ceded loss ratio = 19,200 / 55,040 = 34.9%

(iv)   The capital required will have to be determined (it could use the current capital requirement as a starting point).

A stochastic model will have to be used to calculate the profit commission

It will need to generate a distribution of underwriting returns

…with the profit commission factor as a parameter

It should then vary the profit commission factor to target at least 80% probability of an underwriting profit of more than 5% of the capital required

It should build a model that includes the following:

Underwriting (loss) experience of the underlying risks
Distribution of limits (mix of business) underwritten
Cession rates of risks
How the cession rates vary with the type of risk
There are likely to be maximum and minimum cession rates

The above variables could be modelled from past experience under the treaty,

…or exposure analysis from other treaties (or external data),

…allowing for any likely differences (or trends) in the forthcoming period.

The reinsurer's loss experience can be very different from that of the cedant…

…depending on the cession rates for different types of risk, and where the large losses fall.

The greater the choice that the cedant has over the cession rate, the greater the potential for selection against the reinsurer.

So, there could be considerable interaction between the variables in the model.

For example, higher cession rates might be associated with higher loss ratios.

Even if the cedant doesn't cede more of the high loss ratio risks they may well cede more of the bigger risks, so this needs to be considered too

The reinsurer should allow for this by using multi-way tables, or possibly copulas to generate correlation.

The reinsurer's desire to retain a relationship with the cedant and/or attract more business from the cedant will have to be taken into account

How many years of data to use will have to be taken into consideration

Changes in the terms and conditions of the treaty itself over time

Trending will also have to be considered

The value of any other commission already paid, e.g. return commission

After the profit commission has been determined and the final distribution of outcomes modelled, the reinsurer should consider whether another iteration of the capital model is needed.

In part (i), some candidates didn't give advantages and disadvantages relative to quota share, and made only very generic points. Several candidates mentioned points which are relevant to both types of reinsurance e.g. "cedes profit". Parts (ii) and (iii) were generally well answered, however some said that risk 2 wouldn't be covered because the EML exceeds the capacity of the treaty, even though the question makes it clear that both risks are covered. In part (iv), candidates frequently lost out on marks as they failed to think through the practical aspects of setting the profit commission, or to provide points relevant to the specified situation. Most candidates recognised the need for a stochastic model.

10 (i)   Malicious/deliberate acts carried out by the boat owners

Malicious/deliberate acts carried out by those hiring the boats

Wear and tear

Liability for a peril covered by another policy

Terrorism/war/riot

Losses above a certain limit

Losses below a certain limit

Claims arising from failure of the company to take appropriate risk-reducing actions e.g. ensuring carbon monoxide alarms are fitted, and boilers regularly serviced

Geographic limitations on where boats may be taken

Restrictions on the months/times they can be used

Exclude boats whose speed exceeds a certain value

Exclude high risk activities e.g. racing

Exclude radioactive risks

Illegal or negligent acts
E.g.
       Under influence of drugs, alcohol, other substances
       Negligent behaviour (e.g., open fires)
       Skippered by others than registered owners or authorised hirers
       Exceed number of people on the boat
       Other suitable distinct examples

(ii)   <u>Estimate exposure in each policy year</u>

Assume boats are purchased/sold evenly through the policy year

Policy year	Exposure
1	$0.5 \times (65 + 70) = 67.5$
2	71
3	76
4	82.5
5	87.5

<u>Large claims adjustment</u>

The mean of the negative binomial distribution is $2 \times (1 - 0.99) / 0.99 = 2/99$

So the expected cost in each year is €1,000,000 × 2/99 = €20,202

<u>Develop non-large claims</u>

Policy year	Ultimate non-large claims
1	$56,750 \div 0.9 = 63,056$
2	$57,000 \div 0.85 = 67,059$
3	72,667
4	83,333

Assume inflation will continue at 2% pa for the following policy year

<u>Inflate claims to policy year 5</u>

Policy year	Claims adjusted to year 5
1	$63,056 \times 1.02^4 = 68,253$
2	$67,059 \times 1.02^3 = 71,163$
3	75,602
4	85,000

Check for any trends in claims per unit exposure:

Policy year	Claims per unit exposure
1	$68,253 / 67.5 = 1,011$
2	$71,163 / 71 = 1,002$
3	995
4	1,030

No need to apply any further trending

Burning cost excluding large claims =

total non-large claims / total exposure = 300,019 / 297 = 1,010.17

Risk premium = burning cost × (policy year 5 exposure) + (large claim adjustment)

So risk premium = 1,010.17 × 87.5 + 20,202 = €108,591

Assume no change to type/risk intensity of boats, customers etc. other than that captured in the 2%

Assumes policy conditions are the same (or no material changes) in policy years 1 to 5

(iii)   The premium will have to be adjusted for the following:

Expenses and commission

Reinsurance and catastrophe/large loss loadings

Profit or return on capital and capital loadings

Any discounts or other soft factors e.g. for good claims history or loyalty

Investment return and credit charges e.g. if paying by instalments

Changes in terms and conditions and other coverage changes

Changes in market conditions and the insurance cycle

Premium tax, corporation tax and levies

Other influences on the final premium quoted will include:

Competition and the need to maintain/build market share

The availability of capital to support new business

The impact of reinsurance capacity

The sophistication of sales/quotes systems

The demands of regulators in the rating area

Customer lifetime value considerations or inertia pricing

Company strategy and target market

Relationships with particular distributors/brokers

Part (i) was generally well answered, though some candidates suggested exclusions that would be entirely impractical, e.g. not allowing children on board the boats. Part (ii) was generally answered well, with many students scoring full marks. Some students stated unnecessary assumptions (e.g. assume the given data is correct, or simply repeating information given in the question). The most common reason for losing marks was not calculating a burning cost at each year (to examine trends). Part (iii) was generally answered well.

END OF EXAMINERS' REPORT