

INSTITUTE AND FACULTY OF ACTUARIES

EXAMINERS' REPORT

September 2021

SP8 – General Insurance Pricing Specialist Principles

Introduction

The Examiners' Report is written by the Chief 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.

Sarah Hutchinson
Chair of the Board of Examiners
December 2021

A. General comments on the aims of this subject and how it is marked

The aim of this General Insurance: Pricing Principles subject is to instil in successful candidates the ability to apply, in simple pricing analysis situations, the mathematical and economic techniques and the principles of actuarial planning and control needed for the operation on sound financial lines of general insurers.

Subject SP8 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 SP8 examination.

As well as pricing techniques, SP8 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 lose marks 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.

Candidates who give well-reasoned points, not in the marking schedule, are awarded marks for doing so.

B. Comments on candidate performance in this diet of the examination.

The general performance of candidates was lower than that seen in previous sittings and this is reflected in the pass mark set. The paper was generally well attempted, but many questions were poorly answered as candidates did not answer the question asked or did not tailor the solution to the specific information or situation given. Responses to knowledge questions were generally poorer this sitting, in particular Question 8(ii), Question 9(ii) and Question 9(iii). Questions that tested application and higher order skills proved challenging to many, and candidate responses to these questions generally lacked breadth and detail. Many candidates did not attempt the calculation in the last question however it was not felt that this was due to time pressures. There was some evidence that candidates spent more time on shorter questions and may not have left enough time for the longer questions.

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.

C. Pass Mark

The Pass Mark for this exam was 50
285 presented themselves and 104 passed.

Solutions for Subject SP8 – September 2021

Q1

(i)

The total premium charged (ignoring reinstatement premiums) for the reinsurance divided by the width of the layer covered [1]

(ii)

Reinstatement premiums aren't directly included in the rate on line calculation [1]

Reinstatement premium is received as soon as the first loss hits the layer [1]

and the 5% rate on line suggests the probability of two losses is very low [1]

hence, the expected value of reinstatement premium is likely to be greater than the expected value of a second loss [1]

Rate on line would be lower because expected net payments by the reinsured are lower under the revised quotation [1]

However, this may not always be true because there may be additional loadings to justify the higher coverage and risk. [1]

Or the original rate on line might not be loaded sufficiently, so expected reinstatements might be lower than the expected recoveries from a second loss. [1]

[Marks available 7, maximum 4]

[Total 5]

Part (i) Generally well answered, but a few answers stated that the premium was divided by the "limit", which was unclear.

Part (ii) Marks for this part were very low. Few candidates appreciated that the expected value of the second loss is likely to be lower than 100% of the reinstatement premium and so the rate on line would reduce.

Q2

(i)

The curves represent the severity of different loss distributions. [½]

e.g. Curve B shows that if losses were capped at 20% of the sum insured, the aggregate would make up 80% of the expected uncapped losses (or any other such example) [1]

The steepness of the curve represents how extreme the losses are likely to be ... [½]

... the more severe the closer to the diagonal [½]

The average severity underlying Curve C is likely to be the highest [½]

because it shows the greatest proportion of larger losses. [½]

Losses underlying Curve A are likely to be smallest as most of the losses are expected to be small. [½]

[Marks available 4, maximum 3]

- (ii)
- The actuary would try to understand more about the source of the curves - does it apply to: [½]
- ... the same jurisdiction and claims environment [½]
 - ... the same sub-classes [½]
 - ... the same coverages [½]
- The Actuary should understand any necessary adjustments required ... [½]
- ... do the curves already include expenses and uncertainty loadings [½]
 - ... for inflation, if we do not believe that the effect of claims inflation is uniform across all loss sizes [½]
 - ... to allow for original deductibles (if pricing reinsurance) [½]
 - ... to allow for an inuring reinsurance (if pricing reinsurance) [½]
- The Actuary should check the assumption that the relative loss size distribution is independent of the size of the risk [½]
- The insurer's data could be used to calculate an empirical exposure curve [½]
- ... and plot it on the same graph to see which curve gives the closest fit to the data [½]
 - ... and carry out statistical tests for goodness of fit [½]
- How different are the new curves compared to those already being used in the pricing model? [½]
- ... and how they compare to other benchmarks that the company might have access to. [½]
- Are the calculations for the new curves easy to implement in the pricing tool [½]
- ... are they based on common market curves like the Maxwell-Boltzmann, Bose-Einstein and Fermi-Dirac family of distributions, lognormal, etc. [½]
- Apply the selected curve to historically priced contracts to see how premiums would have changed if this curve had been implemented [½]
- ... and the impact on loss ratios [½]
 - ... will they bring premiums closer to what underwriters have been charging in the market (hence minimize the need for underwriter's adjustment) [½]
- What curves are being used by competitors in the market? [½]
- Will the new curves be acceptable by other brokers? [½]
- ... and regulators? [½]

[Marks available 11½, maximum 6]

[Total 9]

Part (i) Generally well answered, but there was evidence of not understanding what the graphs represent, with a few answers stating that curve A represented higher severity.

Part (ii) Answers varied greatly. Some answers described in detail how to create curves for a pricing exercise, which was not asked for and did not score. Those that related their points to a pricing exercise tended to generate a wider range of points and hence score well.

Q3

- (i)
- Use previous cat losses to estimate likely cost and frequency [1]
 - Build a cat model (this may require expert advice) [½]
 - Or use a proprietary cat model [½]

Use the annual average loss (AAL) shown in the cat model output as a risk premium for the cat exposure	[½]
Liaise with consultants / brokers / reinsurers	[½]
There may be an accepted industry load / approach	[½]
Calculate historical proportion of losses that are cat, and use this to add a load to non-cat estimated risk premium	[½]

[Marks available 4, maximum 3]

(ii)

Which natural catastrophes are they exposed to / do they cover, that could be impacted by climate change	[1]
To what extent will climate change affect the likelihood and/or cost of natural catastrophes	[1]
And how that could vary by line of business, as some may be more exposed to weather-related perils	[½]
Do we know the rate at which climate change is happening?	[½]
Is there any research or industry data that may help?	[½]
Nature of risks covered may change in response to climate change, (e.g. building structures may change to be more green/sustainable, farms may grow different crops less vulnerable to drought say)	[½]
Which perils are covered and which excluded	[½]
Could climate change affect the risk premium for non-cat	[½]
... e.g. attritional weather ...	[½]
... or impact on supply chain (e.g. of buildings materials) and therefore lead to higher claims costs?	[½]
Is there any evidence of changes in recent history that could inform size of adjustment required	[½]
If it writes business in different countries, do rates of climate change vary by location	[½]
Or could the impacts of climate change vary by location?	[½]
Coastal areas are at a higher risk of losses due to rising sea levels	[½]
Are any actions being taken to reduce rate of climate change or its impacts?	[½]
Is there any regulatory or professional guidance around incorporating the impact of climate change?	[½]
Has any allowance already been made for climate change, e.g. via the proprietary cat model	[½]

[Marks available 9½, maximum 4]

(iii)

Economic impacts	
Higher unemployment leading to more credit and income protection claims	[½]
Lower sales and lower demand for products/cover given financial difficulties e.g. move more to TPFT over fully comprehensive, no travel	[½]
Potential reduction in investment return (e.g. government policies to mitigate global warming may reduce the value of holdings in coal mining companies)	[½]
Climate change may have an impact on inflation and/or exchange rates	[½]

[Marks available 2, maximum 1]

Business mix might change – e.g. coal plants and oil rigs shutting down due to rise of alternative energy	[½]
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... which would have an impact on the expense loading	[½]
Companies may be required to pay levies to fund action against climate change	[½]
Reinsurance prices may increase for multiclass reinsurance covers (e.g. if they cover a mix of classes with and without weather exposure) and may increase across the board for all classes (as reinsurers may choose to cross-subsidise the weather-exposed classes to avoid rate hikes)	[½]
Other expenses may change e.g. less business travel	[½]
It may be necessary to cross-subsidise weather-exposed classes by increasing premiums for other classes	[½]
Nature of risks covered may change, e.g. greener designs covered under extended warranty	[½]

Indirect consequential impacts:

e.g. Liability claims, e.g. D&O may rise if directors of companies are found to be negligent in terms of business practices that add to climate change	[½]
e.g. increase in disease and health claims following flooding	[½]
e.g. increase in cat events may lead to increase in non-cat events such as opportunistic theft (looting)	[½]

[Marks available 1½, maximum 1]

Reputationally, customers may choose not to purchase products from the company if it invests in businesses that contribute to climate change	[½]
and/or sell policies to such companies	[½]
There may be regulatory requirements to hold more capital as protection against unknown impacts of climate change	[½]

[Marks available 8½, maximum 3]

[Total 10]

Part (i) This was generally well attempted. This was an “outline” question, but some answers gave a lot of unnecessary detail on a particular approach. Only a few candidates outlined enough different approaches to do very well. Some points did not relate to catastrophe cover (e.g. burning cost method).

Part (ii) Answers varied, but generally this was poorly answered. Some answers did not focus only on the risk premium adjustment and discussed other loadings (e.g. expenses, profit, competition); others did not relate to the impact of climate change (e.g. they gave general premium adjustments or discussed the effects of weather).

Part (iii) Quite well attempted. Some answers were limited to consequential impacts of climate change on non-weather products, but there were better-scoring answers that considered many different impacts.

Q4

The company should try to understand the reasons for reduction in renewals ...	[½]
... premiums higher as compared to competition	[½]
... poor customer service and reputation	[½]

... is the renewal rate reducing only for certain segments of the portfolio (e.g. a certain distribution channel) or across the board	[1/2]
... if the reason is, say, poor customer service, then the marketing manager's proposal doesn't address the key problem	[1/2]
... competitors may be offering a better product/more product features/benefits	[1/2]
The insurer should also look at the percentage of customers lapsing but buying a new business policy?	[1/2]
Are renewal rates falling across the market, e.g. falling demand for motor insurance?	[1/2]
Compare the expected profit for new vs renewal business ...	[1/2]
... it is likely that renewal is more profitable due to lower expenses	[1/2]
... the discount offered would offset the lower expenses	[1/2]
... but if the difference in profit is less than 10%, the discounts will make renewals more unprofitable after the third renewal	[1/2]
It might be useful to investigate the impact on different segments of the portfolio...	[1/2]
... younger drivers might be more likely to renew due to the discount but they may be more unprofitable	[1/2]
... customers acquired through certain distribution channels might be less persistent and causing the reduction in renewals	[1/2]
The choice of 2%, 5% and 10% seems arbitrary.	[1/2]
What does the analysis tell us about tenure/customer lifetime	[1/2]
If largest lapse rate is at 1st renewal then 2% may not be sufficient	[1/2]
We should develop/use a price elasticity model	[1/2]
We should model different structures (e.g. in terms of %s and number of renewals) to identify optimal choices to improve overall profit and achieve strategic goals e.g. in terms of market share	[1]
Each customer might be expected to stay with the company for a longer period of time	[1/2]
... hence reducing expenses and improving overall profitability	[1/2]
... a customer lifetime model can help to estimate this	[1/2]
... the model should also include the cost of implementing such a scheme	[1/2]
... market surveys and the inputs of industry experts might be useful here.	[1/2]
Need to consider the views of brokers.	[1/2]
The current pricing might already account for lower expenses but choose to keep premiums similar for new and renewal business ...	[1/2]
... hence, to maintain the same level of profit while providing the discount, the base premium will have to be increased	[1/2]
... which could cause a fall in new business	[1/2]
The discounts are likely to retain more customers ...	[1/2]
... and even attract new business	[1/2]
... particularly if competitors are not allowing for such discounts	[1/2]

Does the company have the resources – personnel, capital, etc. to support the increase in volume?	[1/2]
And to alter the systems to allow for this change	[1/2]
The reaction of the competitors should be considered, as they could also launch similar schemes to retain customers	[1/2]
It may be appropriate to use different discount structures for different segments or channels ...	[1/2]
... although this would be administratively more burdensome and a simpler structure may be more marketable	[1/2]
There may be other discount structures currently in place ...	[1/2]
... the no-claims discount is common on the motor industry	[1/2]
... and is dependent on claims, hence might be more effective at retaining better risks	[1/2]
How will this proposed discount interact with these other discounts, and how will this be communicated to customers	[1/2]
For example, may have to say discount only available to those who have been claim free in the last year	[1/2]
... otherwise it may negate the effectiveness of an No Claims Discount system in deterring poorer risks	[1/2]
How does this interact with other elements of the rating structure? E.g. natural risk change due to age compounding with this discount?	[1/2]
The company would also consider any regulations or legal issues around offering the discount	[1/2]
e.g. the rates might be tariffed, hence difficult to modify	[1/2]
Simple and easy to understand / implement	[1/2]

[Marks available 24, maximum 10]

[Total 10]

Generally well attempted. Some candidates clearly took time to cover a wide range of different ideas, and they tended to score well.

Q5

(i)

Insurance-Linked Securities (ILS) are financial instruments for which the valuation and performance are controlled by the occurrence (or lack of occurrence) of insurance loss events	[1/2]
ILS investors are entitled to return of the principal along with interest at the end of the period	[1/2]
but typically lose the entire amount if the defined event occurs	[1/2]
This allows insurance companies to transfer the risk of such events to the larger capital market	[1/2]
who benefit from the diversification of different investments	[1/2]

as an alternative to traditional reinsurance	[½]
The investors are likely to get a higher interest payment in return for the additional risk	[½]
Usually done via a Special Purpose Vehicle (which is a separate legal entity that sits between the insurer and investors)	[½]
	[Marks available 4, maximum 3]

(ii)

The company would need to consider:

Their gross exposures to US hurricanes [½]

if there are any concentrations or accumulations of the risk in certain areas [½]

Catastrophe bonds:

are usually activated based on an industry loss or a parametric trigger [½]

but can also be based on actual or modelled losses to the insurer [½]

so the insurer will need to decide which type of trigger to use [½]

is there a trigger that is readily accepted by the market (e.g. government estimated economic/insurance losses or estimations by a cat model vendor)? [½]

Do we have any experience of issuing such bonds and are their other parties we could seek advice from e.g. consultancies [½]

Consider that it will avoid exposure to reinsurance default risk (if using cat XL instead) [½]

Will need to consider specific features:

how extreme should the selected trigger be and whether it fits well with the company's risk appetite [½]

how much and how frequent is the interest payment, Level of return offered – so the company will need to decide on an appropriate level to offer, and how to structure this e.g. fixed or floating [½]

would the defined catastrophe event cover specific regions (e.g. Gulf of Mexico) or would it apply to a country wide exposure [½]

definition of catastrophe event – does it include inland flooding, hours clause, etc. [½]

reinsurance already in place, then company is likely to consider a mixed structure of traditional reinsurance to complement the catastrophe bonds [½]

is such a structure viable without leaving significant gaps in coverage? [½]

Catastrophe bonds are often for periods more than 1 year [½]

which can cause a mismatch in future years if the traditional reinsurance protection changes [½]

Would the relationship with brokers/reinsurers be affected because of the bond issue? [½]

Consider the total cost of issuing the bonds [½]

and compare with the cost of traditional reinsurance cover [½]

The precise cover sought may not be available in the traditional RI market [½]

Consider the position in the reinsurance cycle – is traditional cover becoming more expensive? [½]

Is the company's bond issue likely to be fully subscribed? [½]

this might depend on the company's brand, size of the issue and demand for such products [½]

the rating given to the bonds, which will in turn depend on the probability of the trigger event occurring [½]

Consider regulations that govern such an issue [½]

There's likely to be reduction in capital requirements overall [½]

but not as much as with traditional RI contracts [½]

since catastrophe bond triggers may not always correspond to insurance losses [½]

how does this reflect in the regulator's or rating agency's capital model? [½]
 Likely benefit to liquidity risk as upfront funding (no need to wait for recoveries) [½]

[Marks available 15, maximum 7]

[Total 10]

Part (i) Generally well answered, but a few answers failed to adapt the bookwork to the question asked (i.e. to describing how ILSs work).

Part (ii) Answers varied, but this was generally well attempted and quite well answered. Where candidates structured their answers, this seemed to help in generating points.

Q6

(i)

Products

Directors' and Officers' insurance [½]

indemnifies the insured against the legal liability to compensate third parties [½]

owing to any wrongful act of the insured in his or her capacity as a director or officer of a company [½]

The insurance is personal to the director or officer, but is usually bought for him or her by the company [½]

Employment Practice Liability (EPL) insurance [½]

Covers wrongful acts arising from the employment process [½]

Claims covered under such policies include: wrongful termination, discrimination, workplace harassment, and retaliation [½]

The policies cover directors and officers, management personnel, and employees as insureds [½]

Public liability [½]

Can be triggered as a fallout of the workplace harassment claims [½]

Provides coverage for claims alleging bodily injury [½]

These policies usually also provide cover for investigations by regulatory bodies [½]

Usually on a claims made basis [½]

Employers' liability [½]

Indemnifies the insured against legal liability to compensate an employee or his or her estate for bodily injury or death to an employee due to workplace harassment [½]

Loss of or damage to employees' property is usually also covered [½]

Legal and care costs may also be covered [½]

Legal expenses [½]

Indemnifies the insured against legal expenses incurred as a result of legal proceedings being initiated against the insured [½]

And the need for the insured to initiate legal proceedings [½]

Legal expenses will normally cover the payments made to legal representatives [½]

Sickness / Income Protection (usually bundled with Accident and Unemployment cover) [½]

Pays insured monthly benefit	[½]
In the event that the insured is unable to work as a result of stress (possibly brought on by harassment)	[½]
Health insurance	[½]
Provides cover for the cost of medical care in the event of harassment	[½]
e.g. therapy/support for mental wellbeing	[½]

[Marks available 13½, maximum 7]

(ii)

Risk mitigation:

Reinsurance	[½]
Risk Excess of Loss (XL) will reduce large claim exposures	[½]
Quota Share reduces overall risk levels	[½]
stop loss may limit downside depending on availability	[½]
aggregate XL for accumulations of risk	[½]
Adverse development cover or loss portfolio cover for latent claims	[½]
Use of exclusions	[½]
Tight policy wording	[½]
High excess	[½]
Cutting back / stopping insuring certain industries	[½]
Reduce limits on cover provided	[½]
Limit number of individuals from any one company that can be covered (to reduce concentration risk)	[½]
Background check on the company and its management to check for related cases in the past	[½]
Meet with the insured's Human Resources team as part of underwriting to ensure established company policies around reporting and handling of harassment claims	[½]
and compulsory regular staff training around this topic	[½]
Increase/Enhance fraud detection to reduce fraudulent claims	[½]
Ensure that prices charged for relevant insurances allow for the possibility of a rising trend in claims relating to harassment, some of which could be very late-reported claims	[½]
May wish to reduce exposure to regions where awards are likely to be higher	[½]
Reduce the discovery period, e.g. for Directors' & Officers', so that fewer late-reported claims are covered.	[½]

[Marks available 10, maximum 4]

[Total 11]

Part (i) Many answers gave a lot of detail explaining how or why the products could be impacted, whereas the question only asks candidates to describe the products. Many answers included the main products, but some failed to describe them at all. Some gave products (e.g. business interruption, professional indemnity) that were not deemed to be significantly impacted by harassment cases.

Part (ii) Quite well answered generally, with some answers giving enough different ideas to score very highly. Some gave too many similar ideas (e.g. to do with company policies to reduce potential claims), and so their marks were limited.

Q7

(i)

Combined ratio seems to be less than 100 since 2016 [½]

hence this class of business appears to be profitable [½]

Though we don't know if the expense ratio has been stable or volatile,
or is there a trend? [½]

We must check if the 30% expense ratio includes both Allocated Loss Adjustment
Expenses and Unallocated Loss Adjustment Expenses [½]

Need to clarify if these loss ratios are net or gross of any reinsurance that might
already be in place [½]

Is the profitability enough to cover profit loading or cost of capital [½]

after accounting for investment returns [½]

Loss ratios appear quite volatile [½]

there are likely to be large losses that should be taken out and analysed separately [½]

the loss ratio for 2015 is particularly high [½]

Low loss ratio in 2020 may be related to the Covid pandemic in some way.

E.g. multiyear cover taken out but few claims due to less work being done
than expected [½]

Recent falling trend in loss ratios [½]

this could be because of better than expected experience [½]

or an increase in premium rates [½]

stricter underwriting [½]

there could also be a change in claims reserving [½]

or an incorrect calculation of ultimate claims [½]

e.g. unsuitable development pattern, Bornhuetter-Ferguson initial loss ratio,

Incurred But Not Reported missing etc. [½]

the underwriting cycle [½]

improved claims handling [½]

improvements in construction technology may be resulting in fewer claims over time [½]

Overall history is still quite short [½]

as construction contracts can have a long exposure period [½]

hence is there any fully developed, robust data to base the development patterns on [½]

We should also look at earned loss ratios [½]

keeping in mind that construction risks don't earn uniformly over the project period [½]

Split the data further by industry, country, etc. [½]

Have the risks covered been of a similar type or has mix of business changed? [½]

What has the overall market experience been over the same time frame? [½]

[Marks available 14½, maximum 7]

(ii)	
Surplus reinsurance allows insurers to fine-tune their exposure	[1/2]
surplus reinsurance will allow the insurance company to cede a larger proportion of the riskier constructions	[1/2]
hence retained risks will be less volatile in size	[1/2]
and losses will be more predictable	[1/2]
The increased predictability may reduce capital requirements (per volume of business written), allowing more business to be written	[1/2]
The greater predictability may also allow better planning, which could lead to improved returns on capital	[1/2]
The reduction of exposure will allow the insurer to grow this class of business or diversify with writing other classes	[1/2]
The additional capacity can also be deployed in writing a more diverse book across different industries, geographies	[1/2]
A diversified book of business will reduce the capital requirements allowing the free capital to earn more investment returns	[1/2]
or allow more business to be written with the same amount of capital	[1/2]
this will improve the return on capital	[1/2]
Can reduce the expense ratio through reinsurer's commissions	[1/2]
and fixed costs that are divided across a larger number of risks	[1/2]
The insurance company will have capacity to write larger risks which may be more profitable	[1/2]
The reinsurer could also provide their expertise through improvements in the pricing process	[1/2]
or improvements in business monitoring	[1/2]
All of the above needs to be weighed against the fact that purchasing surplus reinsurance cedes profit to the reinsurer	[1/2]

[Marks available 11, maximum 6]

[Total 13]

Part (i) Well attempted generally, but only a few answers gave enough different comments to do very well. It was good to see many answers related to construction business (e.g. long, non-uniform exposure period). A common misconception was that the expense ratio has remained constant, whereas it is clearly stated that the 30% is an average.

Part (ii) Well attempted. Some wasted time describing surplus reinsurance in detail. Stronger answers related to improving return on capital. A wide range of clearly-explained ideas was required to gain full marks.

Q8

(i)

The Actuary wants a quick, simple model	[½]
Doesn't have sufficient data to model frequency and severity separately	[½]
Useful check against a single risk premium model (derived by combining frequency and severity models)	[½]
may identify weaknesses in the risk premium model	[½]
Quickly identify factors that could be used in rating	[½]
Identify changing trends in burning cost	[½]

[Marks available 3, maximum 2]

(ii)

The distribution of the observed burning cost will have a point mass at 0 combined with a spread across non-zero amounts	[1]
The gamma distribution would not be appropriate for this shape of values	[½]
A Tweedie distribution would be more appropriate	[½]

[Marks available 2½, maximum 2]

(iii)

If the chosen error structure is appropriate, the average residual should be zero, i.e. the residual plot should be symmetrical about the x-axis and the range of the residuals should be fairly constant across the width of the fitted values.	[1]
The plot shows a mean below zero, or alternatively the residual plot is not symmetrical about the x-axis	[½]
however the range of residuals is constant in size	[½]
The deviance residuals are closely normally distributed	[½]
so you would expect the deviance residuals at a given fitted value to have an approximately normal distribution	[½]
This plot shows a skewed distribution	[½]
and there is an odd pattern at the extremes	[½]
The error structure / distribution function in this case is wrong	[½]

[Marks available 5, maximum 3]

(iv)

Residuals are used to calculate the deviance	[½]
which in turn are used in statistical tests to assess the significance of factors:	[½]
e.g. a chi-squared test on the difference in scaled deviances	[½]
or an F-test where the change in deviance is the numerator of the test statistic	[½]
Pearson residuals are used in the calculation of Cook's distance	[½]
which is used to estimate the influence of a data point on the model results	[½]
Points with a Cook's distance of 1 or more are considered to merit closer examination in the analysis	[½]
Data points with large residuals may distort the outcome and accuracy of a regression	[½]
and should be investigated and possibly removed	[½]

[Marks available 4½, maximum 2]

(v)

Licensing agency data	[½]
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might give up-to-date data on driving experience and any driving convictions	[½]
longer experience suggests lower risk	[½]
and type and recency of driving convictions will also indicate driving behaviour and care which will be reflective of risk	[½]
in addition the information may be used to check against what the customer declares in their quote if trying to get a cheaper premium	[½]
Previous insurer / industry claims database	[½]
record of previous claims to use directly or check against declared claims	[½]
Motorcycle trade data	[½]
this will contain data that may be useful at categorising cycles by size / power / speed / cost / make / model	[½]
may be indicative of repair costs/salvage value	[½]
repair costs by location	[½]
National crime statistics	[½]
may highlight areas / regions where theft of and/or damage to cycles is higher / lower than average	[½]
such data may be sparse but could be modelled to smooth across a wider set of data	[½]
National motorcycle accident statistics	[½]
may show location of accident hot-spots which may lead to loads for those who live near these hot-spots	[½]
Census data	[½]
may give socio-economic type factors such as level of education and/or wealth, which could be an indicator of risk and likelihood of keeping their cycles in good condition	[½]
Any national statistics on road types and conditions	[½]
motorcyclists may be at greater risk on certain road types, or on rural roads, so those living in these areas may be charged more	[½]
Traffic volumes/population density where policyholder lives	[½]
as busier roads may have higher accident frequency	[½]
Insurance industry data (ABI/MIB) relating to various statistics e.g. number of uninsured drivers, wider industry experience of performance	[½]
help benchmark own experience against the market	[½]
Info on cross-product holdings, e.g. if the policyholder also has a policy for their car or house with the insurer	[½]
might be indicative of e.g. propensity to claim	[½]
Credit reference agency	[½]
may be indicative of propensity to claim	[½]

[Marks available 14, maximum 7]

[Total 16]

Part (i) Most candidates got the first two points above, however very few made additional points beyond these that scored.

Part (ii) Many candidates failed to realise that burning cost will have a point mass at 0 (where policies have not had claims), but those that did, tended to score full, or almost full, marks.

Part (iii) This part was well attempted. Answers that focused on the criteria that make an error structure appropriate tended to do better.

Part (iv) This was answered fairly well. Some candidates missed the word "other" in the question and commented only on residual plots.

Part (v) This was well attempted. Unfortunately, many answers discussed cars rather than motorcycles, and candidates should take care to tailor their answers to the specifics in the question. Most candidates tried to explain how each source could be predictive of claims. Alternative valid sources / explanations were credited if they were deemed to be relevant and deemed to have a significant impact on claims.

Q9

(i)

Frequency:

A higher deductible will tend to decrease frequency, or vice-versa [1]

Severity:

There is no fixed relationship between the level of deductible and the severity [½]

e.g. removes small claims and reduces size of larger ones, or other suitable example [1]

If all claims (no matter how small) were reported, a higher deductible would be expected to reduce the average net value (if nil claims are included in the calculation) [½]

However, many people will choose not to report claims below the deductible (or even just above the deductible). Because of this, we would expect the average gross value of claims reported to increase if the deductible increases [½]

[Marks available 3½, maximum 2]

(ii)

Approaches:

An incurred development factor can be applied to open and closed claims [½]

This factor reflects the maturity of the claim [½]

Case estimate development factors would only apply to open claims [½]

and they will be higher than incurred development factors at the same maturity [½]

to offset the effect of not developing closed claims [½]

Compared with the incurred development factor method this may give a more accurate / realistic estimate, especially if deductibles are involved [½]

To allow for losses not in the data set, the ultimate size needs to be assumed [½]

this will be derived from known losses [½]

we could look at the historical relationship between the size of late reported claims and other claims to inform our chosen assumption [½]

Stochastic development methods can capture the variation in individual ultimate loss amounts around each of their expected values [1/2]
 [Marks available 5, maximum 4]

(iii)
 The development pattern should ideally be based on the insured's own experience [1/2]
 to allow for its own mix of claims and claims handling processes [1/2]
 Consider if the underlying data has changed over time [1/2]
 Suitable examples:
 have different insurers held the risk over the period being considered? [1/2]
 has the claims reserving philosophy changed? [1/2]
 or have claims handling procedures altered or been impacted by other factors such as staff shortages [1/2]
 have policy terms and conditions changed? [1/2]
 Is there enough credibility within the insured's own data? [1/2]
 or do benchmark patterns need to be applied? [1/2]
 benchmark patterns used should come from portfolios that have similar characteristics i.e. same class of business, similar terms and conditions, similar mix of business [1/2]
 development triangles may not be available for an individual insured [1/2]
 Pattern should be appropriate to the losses being developed [1/2]
 e.g. for an excess layer, it would not be appropriate to apply a ground up development pattern [1/2]
 Should different development patterns be applied for losses within different size bands? [1/2]
 this approach may only be used for high excess layers due to the complexity of this approach [1/2]
 Period we should base development factors on [1/2]
 [Marks available 8, maximum 4]

(iv)

Column A	Column B	Column C	Column D
Observation (x)	$F(x)$	$F_n(x)$	$ F_n(x) - F(x) $
0.6	0.847	0.2	0.647
0.8	0.905	0.4	0.504
1.0	0.938	0.6	0.338
1.2	0.957	0.8	0.157
1.4	0.970	1	0.030

[1] [1] [1]

The Kolmogorov-Smirnov statistic is the maximum from the last column i.e. 0.647 [1/2]

Critical values are:

Level of significance	10%	5%	2.5%	1%
Critical value ($n = 5$)	0.546	0.608	0.662	0.729

[1]

Test statistic of 0.647 is between critical values at 5% and 2.5% [1/2]
 Therefore reject null-hypothesis at 5% significance level [1/2]
 But do not reject at 2.5% significance level [1/2]

[Marks available 6, maximum 6]

[Total 16]

Part (i) Most answers scored on the frequency aspect but missed the point that a change in deductible could affect severity in either direction. Some explanations did not make clear what the “change” was (i.e. an increase or decrease), and so could not score.

Part (ii) Most candidates spotted the relevant bookwork, and also compared the two main methods, and so did very well. Some answers did not answer the question asked – for example, describing in detail how to develop individual losses.

Part (iii) Only a minority of candidates identified the relevant bookwork and so answered this very well.

Part (iv) A significant number missed this part out entirely. Of those that attempted it, nearly all calculated the critical values correctly, and most correctly calculated values for $F(x)$. The most common difficulty was deriving the EDF step function, even though this was highlighted in the question. Some candidates got this wrong, but scored follow-through marks for using these values to perform a correct KS test. There were some fully correct calculations. Nearly all attempts showed sufficient workings, which was pleasing.

[Paper Total 100]

END OF EXAMINERS' REPORT