Institute and Faculty of Actuaries

EXAMINERS' REPORT

SP8 – General Insurance Pricing Specialist Principles

September 2022

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 2022

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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 products. 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 not be awarded 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 paper was generally well attempted and only a small number of candidates did not complete certain question parts. Marks were often low due to candidates not answering precisely the question asked or not tailoring solutions to the specific information or situation given. Responses to knowledge based questions were generally good. Questions that tested application and higher order skills proved more challenging, and candidate responses to these questions sometimes lacked the breadth and detail needed to score well. 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.

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C. Pass Mark

The Pass Mark for this exam was 57.
316 presented themselves and 134 passed.

Solutions for SP8 – September 2022

Q1

The mix of customers is likely to be different [½]
e.g. the motor dealerships might bring customers who may be better off, drive more carefully and are probably older, or the customers may be higher risk [½]
All else being equal, dealership customers may have a different propensity to claim [½]
The mix of vehicles might also be different [½]
e.g. some dealerships might deal only in luxury brands [½]
It might not be possible to consider certain rating factors while selling through dealers [½]
or alternatively additional rating factors can be considered that are not recorded online or different rating factors or model is used for dealerships [½]
Data obtained from dealers might have more data errors due to manual inputs [½]
or some fields left blank which is easier to control in an online submission. [½]
The risk premium for this distribution channel might be updated less frequently. [½]
There may be a delay in claims notification and settlement if notified through the dealer [½]
which might make it more difficult to estimate the risk premium accurately [½]
Lack of data for this distribution channel might result in an incorrect pure risk premium being calculated [½]
Cover provided or T&Cs may be different for dealership policies [½]
A different method may be used to determine the risk premium for this channel (e.g. could be a knock-on effect of differences in data) [½]
Bad risks may be more likely to be declined through one of the channels, which would affect the expected cost of claims [½]
(No marks for loadings/market factors etc. because they do not relate to pure risk premium)
[Marks available 8, maximum 3]

This question was generally well answered. A number of candidates gave lots of points about loadings such as expenses even though the question specifically asked about the pure risk premium. As a result, these candidates tended to score low marks. It was good to see many answers making reference to motor insurance and the distribution channels in question.

Q2

Have any price changes been made over the last 3 months [½]
Has the market made any significant rate changes / what stage is the underwriting cycle in [½]
Have specific competitors taken pricing actions [½]
or relaxed their terms & conditions [½]
or improved promotion/marketing/branding efforts [½]

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or perhaps introduced better cover [½]
Are there new entrants to the market [½]
Has the product coverage changed and is now less attractive to customers [½]
Investigate strictness of underwriting, e.g. how does declinature rate compare with the rest of the market [½]
Investigate if there has been a change in strategy that could be causing a fall in sales, e.g. narrowing of target market [½]
Are the rates charged by the rating engine the ones intended, i.e. could there be an error in the rating engine resulting in high premiums being quoted [½]
Have there been any issues with the quote and buy system or other problems in customer service – investigate through surveys or monitoring quality of customer calls [½]
Look at how quote conversion rates/new business rate/new business volumes have changed over time [½]
and whether any particular rating segments have seen bigger changes than others [½]
Is the lower sales figure due to a higher than expected number of lapses/lower number of renewals [½]
As with quotes, look at lapse rates/renewal rates over the period [½]
and investigate the drivers of the changes [½]
Check the plan figures are appropriate, there may have been an error [½]
Or was it too optimistic, did it allow appropriately for seasonality, other reason? [½]
Is it just this product or is the same true for other products sold by the insurer [½]
investigate if there's a problem with brand/reputation, e.g. bad press about treatment of claimants [½]
Is it for a specific distribution channel or broker [½]
could investigate if there have been any problems with broker relationships, e.g. may not be sufficiently incentivised if commission offered is below market norms. [½]
Has marketing changed or stopped altogether / Investigate effectiveness of marketing actions [½]
Have there been any regulatory changes [½]
removal of certain compulsory insurance may lead to lower take up, or other suitable example [½]
or just lower demand for such products across the market? [½]
e.g. due to external factors, such as a recession [½]
Speak with underwriting team to understand any qualitative reasons for reduction in volumes [½]
(Other valid points - maximum 1 mark)

[Marks available 14½, maximum 6]

This question was generally well answered and most candidates made a good attempt at it. Those giving a wide range of points scored well. Some however went into more detail than necessary on certain points and failed to generate a sufficient range of ideas. Some responses did not "describe the investigations", and some gave details of general pricing investigations as opposed to focusing on sales. These tended to do less well.

Q3
(i)

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To fill gaps in insurance cover that may not be available from the traditional insurance market [½]
To manage the total insurance spend of large companies or groups of companies / to reduce cession of profit margins to the insurance companies [½]
To enable the enterprise to buy cover directly from the reinsurance market rather than direct insurers [½]
To focus effort on risk management [½]
To gain tax and other legislative or regulatory advantages [½]
To accept external risks on a commercial basis so that the insurance premiums paid by the parent are tax-deductible [½]
To avoid credit risk associated with external insurers. [½]
To gain direct access to reinsurers' expertise [½]
A captive may reduce premiums in recognition of good experience more quickly than an external insurer would [½]
To make insurance premiums more predictable, by reducing exposure to the insurance cycle [½]

[Marks available 5, maximum 2]

(ii)
The employee is partially correct: monitoring the written business is probably less important compared to an independent insurer [½]

because:
most transactions are between the parent company and the captive [½]
incorrect pricing or incorrect reserving can, therefore, be adjusted for later to some extent, and charged back to the parent company [½]
capital can be moved between the two companies to manage a surplus or deficit [½]
renewal of the contracts with the parent company are virtually guaranteed [½]
hence, statistics like renewal rates, strike rates and new business volume are less useful [½]
(Other valid points - limit to 1 mark)

However, monitoring has a lot of uses even for a captive [½]
Sometimes accept external risk (e.g. parent company customers) [1]
The company would still want to manage claims so that costs are kept within budget [½]
and reserves are adequate [½]
and the premium charged is reasonable [½]
and to ensure sufficient resources to handle claims [½]
which in turn helps to allocate costs accurately to the parent companies, departments and classes of business [½]
Reinsurers may be hesitant to provide cover without reliable business monitoring data being available [½]
asset liability matching [½]
Monitoring and managing claims volatility because of [½]
Planning and managing reinsurance [½]
Capital Requirements [½]
Regulatory reporting and compliance [½]
Compare premiums to those charged in the market to ensure that the captive is still cost efficient [½]
(Other valid points - limit 1 mark)

[Marks available 10½, maximum 6]

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[Total 8]

Part (i) was knowledge based and well answered with most scoring full marks.

Part (ii) was generally well attempted but performance was mixed. Many answers did not give any reasons to support the statement. Some merely stated knowledge based reasons for monitoring instead of tailoring points to the situation given. This limited the marks that could be awarded.

Q4

(i)

Cancellation by tour operator / travel agent	[½]
Accommodation no longer being available	[½]
Cancellation of flight/travel by operator	[½]
Delay in flights/trains above a certain threshold	[½]
Missing connecting transportation due to such delay	[½]
Cancellation by policyholder due to unforeseen circumstances	[½]
Or if holiday is cut short, e.g. need to return urgently because of unforeseen serious illness of close relative	[½]
Loss of luggage in transit	[½]
Damage to luggage in transit	[½]
Theft from hotel/accommodation (if not covered by other insurance)	[½]
Medical costs in case medical assistance required whilst abroad	[½]
Repatriation costs in event of death whilst abroad	[½]
Theft/loss of passport/driving licence	[½]
Theft/loss of personal money	[½]
Personal accident cover	[½]
Personal liability cover	[½]
Specialist equipment cover, e.g. skis	[½]

[Marks available 8½, maximum 4]

(ii)

Information about claims costs should be comparable	[½]
may need to be careful around seasonality. Those with annual policies may be more likely to travel at less popular times of year for travel, and we may have a lack of data relating to these times of year	[½]
however when insuring a single trip the destination will be known and can be allowed for	[½]
For an annual policy, although regions of the world may be specified, it won't be known which countries will be visited	[½]
and this creates uncertainty as costs will vary by destination.	[½]
Those with annual policies may visit destinations seldom visited by those with single-trip insurance	[½]
So the data might lack information on these destinations	[½]
Claim frequency will be difficult to estimate because we cannot tell from single trip data how many trips an individual policyholder might make in a year	[1]
although it may be possible to infer some information from multiple single trip covers purchased by the same policyholder	[½]

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this could be more complex because customers purchasing annual policies would expect to travel more than the average traveller [½]
The frequency also varies by destination so again difficult to estimate what that would be for an annual policy [½]
The mix of business may not be similar [½]
e.g. regular/experienced travellers who would purchase an annual policy may be less likely to claim than a single trip customer [½]
however their claim costs may be higher as multiple trips suggests higher than average disposable income [½]
Should have a large volume of internal data as the insurer has sold single-trip policies for many years [½]
whereas obtaining external data may be expensive, less granular and less relevant. [½]
Policy admin expenses could be lower/more predictable [½]
Policy conditions / cover may be different (so data less relevant) [½]
in particular, excesses/limits likely to apply differently [½]
(Other valid points - maximum 1 mark)

[Marks available 10, maximum 4]
[Total 8]

Part (i) was generally well answered with many high-scoring answers.

Part (ii) was well attempted but answers varied. Those that concentrated on the differences between single-trip and annual-trip travel insurance data tended to score better. A number made largely generic points about insurance data, which is not what the question asked for.

Q5
(i)
The policy indemnifies the club when a player is not able to perform due to a sports injury. A fixed lump sum insured or amount per week/month will normally be specified in the policy [½]
and the club will receive this until the athlete is available to perform again [½]
or until the duration specified in the contract has expired [½]
The club may be allowed to select their level of cover [½]
Or it may be linked to the athlete's salary [½]
with a deductible in place to avoid moral hazard [½]
There may be a minimum period of non-availability before a claim can be made [½]
The policy may also cover the change in the athlete's market value if they sustain irreparable injury [½]
though this may be difficult to determine [½]
There may be exclusions in place for injuries sustained outside of club related activities e.g. injury while training or performing for their country [½]
Reputational damage to the club [½]
Lump sum to club if permanently disabled, so unable to compete again [½]
or similarly as a result of accidental death [½]
Cost of recruiting/training a temporary or permanent replacement. [½]

The policy might also cover:

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Reduction in ticket sales [½]
Loss of revenue to the club, e.g. from merchandise sales [½]
Medical / physiotherapy / rehabilitation costs [½]

[Marks available 8½, maximum 4]

(ii)
Directly reduces risk because the insurance company shares a portion of the premiums and claims with the reinsurer [½]
Allows them to improve their solvency ratio & meet statutory requirements. [½]
Enables the insurer to free-up capital [½]
Or allow a more aggressive investment strategy [½]
Enable the insurer to write a larger portfolio [½]
and increase diversification, e.g. across clubs from different sports or countries [½]
which is particularly important because the insurer only issues one kind of policy [½]
Overall leads to more efficient use of capital, hence better return on capital [½]
The reinsurer pays commissions under the contract which can help with cash flow [½]
and/or ceding commission is currently attractive [½]
The reinsurer may be able to share technical expertise [½]
or help with rating, underwriting and claims management [½]
There may be a regulatory requirement to purchase in the country where the insurer operates [½]
Quota share might be administratively simpler compared to other forms of reinsurance [½]
Quota share may increase the level of diversification if a reciprocal arrangement was used [½]
May appear more secure to investors, credit agencies and the regulators [½]
(Other valid points - maximum 1 mark)

[Marks available 8, maximum 4]
[Total 8]

Part (i) was well attempted and most candidates got some of the points available. A common mistake was to focus on benefits that did not protect the club, for example income protection for the injured athlete.

Part (ii) was generally well answered however few gave enough ideas or details to score full marks. The better answers were tailored to the situation given, i.e. quota share reinsurance and the fact that it exclusively issues policies to protect clubs from non-availability of athletes due to injury.

Q6
(i)
Factors:
Eco friendly – no harmful emissions [½]
although the production of e-scooters still has an impact on the environment [½]
Gets traffic moving – using an e-scooter instead of bulkier vehicles [½]
Encouraging the population to become more active e.g. if the use of an e-scooter can mobilise more people [½]
thereby reducing the burden on the state e.g. healthcare costs [½]
The cost of the trial, and the criteria by which its success or failure will be judged [½]

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Price considerations, e.g. cost per ride, affordability for riders [½]
Cost effective for the users – no need for petrol [½]
Demographic of the users – more likely to be used by the younger population rather than the older ones [½]
Excludes potential users who do not have access to a smartphone. [½]
Can the infrastructure cope with the rollout e.g. enough charging points / docking stations, suitability of road network. [½]
What kind of license required for riders – what if have convictions, penalty points, or an overseas licence say? [½]
Compliance – who will check the validity of driving licence? [½]
Is suitable insurance available? [½]
What area to be chosen for the test? [½]
Probably an area where public transport is lacking. (or other suitable example). [½]
Safety concerns / requirements (e.g. a helmet may be required) / speed restrictions on scooters [½]
How the risk of public injury will be managed [½]
Consider whether this scheme is in line with any similar schemes in place in other developed countries [½]
Scooter provider – their reputation, quality of scooters, maintenance, regulation etc. [½]
Popularity of proposal / public demand / political impacts [½]
Scope of the trial, e.g. size of trial area, time period [½]
Issues around use of mobile app, e.g. ease of use and cyber risks [½]

[Marks available 11½, maximum 5]

(ii)
Coverage:
Public liability / TPL cover [½]
indemnifies the insured against the legal liability for the death of or bodily injury to a third party [½]
or for damage to property belonging to a third party. [½]
The cover provided may be limited by legislation [½]
Personal accident cover [½]
Provides compensation in the event of bodily injury or death of the rider [½]
Cover likely to include emergency medical treatment [½]
Legal expenses cover [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]
Breakdown assistance cover [½]
Cover against damage to mobile phone as a result of using the app [½]
There may be a (small) excess on some coverages which the rider is liable for [½]
(Other valid points - maximum 1 mark)

[Marks available 8½, maximum 5]

(iii)
Exclusions:
E-scooter being used by anyone other than the rider [½]
or by more than one rider [½]
E-scooter being used for any purpose other than social, domestic and pleasure [½]
E-scooter being used outside the defined territory [½]

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E-scooter being used in an unsafe or un-roadworthy condition [½]
Accidents arising through poor maintenance / normal wear and tear [½]
Events where there is another insurance policy in place which covers the same or similar risk(s) [½]
Any loss or damage to property which belongs to the rider [½]
Any loss resulting from fines and/or penalties (whether civil or criminal) [½]
Criminal defence costs where the user either was under the influence of drink or drugs at the time of the accident, speeding or riding dangerously, or is charged with leaving the scene of the accident [½]
The user's death or bodily injury where it is attributable to illness or disease, unless the direct result of an accident [½]
Any head injury suffered by a user where they are not wearing a helmet at the time of the accident [½]
Any loss or damage arising from an accident which was caused or contributed to by the user's deliberate or reckless act e.g. the user either was under the influence of drink or drugs, or breaking a traffic rule [1]
Losses arising from a rider that does not have a valid driving licence [½]
Exclude certain types of e-scooter above a certain level of horsepower or size [½]
E-scooter being used at certain times of day, e.g. during hours of darkness (depending on rules of the scheme) [½]
Injuries while on scooter but due to e.g. civil riot, terrorism or earthquake [½]
There may be an age limit for personal accident e.g. over 65 [½]
Accidents reported after a certain time period may be excluded. [½]
Damage to smartphone not caused by the app [½]
(Other valid points - maximum 1 mark)

[Marks available 10½, maximum 5]
[Total 15]

Part (i) was well attempted and those that generated a wide breadth of points scored well.

Part (ii) was generally well answered, only a few responses had enough different valid points to get full marks.

Part (iii) was well attempted, but as in part (ii) those that gave a variety of distinct points did best.

Q7
(i)
Complement qualities:

Accuracy as a predictor of next year's mean loss costs:
Which method is more accurate will depend on factors like, for example, how volatile experience in class X is compared with class C in general [½]

Unbiasedness as a predictor of next year's mean-expected losses:
The expected value for class X in state Y would be expected to differ from the expected value for class X based on all states [1]
e.g. differences between states in terms of legislation, insurance regulations,

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demographics etc. [½]
so method A contains an intrinsic bias and inaccuracy that is unknown. [1]
Similarly B is biased (though the bias and its direction are unknown) and so it is inaccurate [½]
e.g. differences in claim frequency and severity between class X and class C [½]
However the bias under B can be reduced by making more adjustments to the class C data to address differences between class C and class X. [1]

Independence from the base statistic:
Method A generally has some independence from the base statistic. [½]
As long as the base (losses in State Y) does not dominate in the whole group, the process errors of all other States should be independent from that of the base. [1]
And the error created by using the group mean instead of the mean for State Y only is independent of the base state process error [1]
To the extent that the actuary uses the same loss development, trend and current level factors in all States, the error from those factors is interdependent between the State Y and group loss costs [1]
Under method B the independence may be slightly less if the classes' similarities mean that common drivers can generate high losses for both classes at the same time [1]

Availability of data:
Usually available under method A [½]
The company writes some related class so data should be available for method B and already computed for that class's rates [½]
But data required to make any adjustments might not be so readily available [½]

Ease of computation:
Method A is the easiest to compute [½]
Under method B, the computations involved in adjusting related class data may be more difficult [½]
Time taken to calculate the complement likely to be longer for method B, due to the need to make adjustments [½]
More likely for errors to occur when calculating the complement using method B, due to the need for judgment in making adjustments [½]

Explainable relationship to the loss costs of the class being rated:
Arguably method A will be easier to explain as it's based on data from the same class of business [½]
On the other hand, under B, since there is some relationship between the base class and the related class (by definition), explaining this complement may be easier than A [½]
[Marks available 14, maximum 10]

(ii)
Number of policies that renew is binomial with parameters n=5,400 and p=0.6
$\mu = np = 5{,}400 \times 0.6 = 3{,}240$ [1]
$\sigma^2 = np(1-p) = 5{,}400 \times 0.6 \times 0.4 = 1{,}296$ [1]
Probability of observed being within ±2% of 3,240 is given by
$2\Phi\left(k\frac{\mu}{\sigma}\right) - 1$ [½]

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$= 2\Phi\left(0.02 \times \frac{3240}{\sqrt{1296}}\right) - 1$ [½]

$= 2\Phi(1.8) - 1$ [½]

= 2 x 0.96407 – 1 [1]

= 0.92814 [½]

Alternatively,
$\mu = np = 5{,}400 \times 0.6 = 3{,}240$ [1]
$\sigma^2 = np(1-p) = 5{,}400 \times 0.6 \times 0.4 = 1{,}296$ [1]

Probability of observed number of renewals being within ±2% of 3,240 equals probability of observed number being in the range of integers [3176, 3304] [½]

If X is the number that renew, then

$P(3{,}176 \leq X \leq 3{,}304)$

$\approx P\left(\frac{3{,}175.5-3{,}240}{\sqrt{1{,}296}} \leq Z \leq \frac{3{,}304.5-3{,}240}{\sqrt{1{,}296}}\right)$ using Normal approx. to binomial with continuity correction [1]
$\approx P(-1.792 \leq Z \leq 1.792)$
$\approx 2 \times 0.96327 - 1$ *(this uses $\Phi(1.79)$ but accept interpolation)* [1]
≈ 0.92654 [½]

[Marks available 10, maximum 5]
[Total 15]

Part (i) proved to be the most challenging question in the paper. Most candidates made a good attempt but struggled to make well-reasoned arguments. Those that structured their answer, considering each quality in turn tended to score better.

Part (ii) was well answered with many fully correct answers. A common error was to apply a Poisson distribution rather than binomial.

Q8
(i)
Error distribution = binomial [½]
Link function = logit [½]

(ii)
$\ln\left(\frac{p}{1-p}\right) = LP$ [1]

$\frac{p}{1-p} = e^{LP}$

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$\frac{1-p}{p} = e^{-LP}$

$\frac{1}{p} = 1 + e^{-LP}$

$p = \frac{1}{1+e^{-LP}}$ [1]

(iii)
Above age 30, the likelihood of renewing increases with age [½]
in particular, all else being equal, those in the 30-49 age group are least likely to renew. [1]
The 70+ group are most likely to renew, [½]
and the 50-69 age group are next most likely to renew [½]
Likelihood of renewing is highest when renewal premium is much cheaper than premium paid last year [1]
This likelihood reduces as the renewal premium becomes less cheap / more expensive. [1]
The likelihood of renewing really drops when the renewal premium increases by more than 25% over the premium paid last year [1]
The model contains an interaction [½]
The first two age groups are much more sensitive to premium increases at renewal. [1]
Increases or decreases in premium of up to 5% do not appear to affect probability of renewal, or it may be that the effects on renewals of increases and decreases in this group (0.95 – 1.05) cancel out [½]
(Other valid points -maximum 1 mark)

[Marks available 7 ½, maximum 5]

(iv)
LP= 1.34 + 0.38 -1.42 +0.42 = 0.72 [1]
p = 1/(1+exp(-0.72)) [½]
p = 0.6726 [½]

(v)
The model could have unintended consequences [½]
which may be in breach of certain regulatory rulings [½]
The data input may be wrong and there is no way of checking the model [½]
Or the data may have been input correctly but interpreted differently by the new package [½]
No user manual could lead to misunderstanding about the workings of the model [½]
By not understanding how the model works it may not be possible to interpret the output. [½]
No user manual could make it harder to peer review and validate the model [½]
No user manual could make it harder to spot errors and inconsistencies in the model. [½]
Key person risk within the team, if those involved in developing the model leave the company, the knowledge relating to the model will be lost [½]
The marketing model may produce very different or contradictory outcomes to the pricing one which may lead to inconsistent action or messages to customers. [½]
E.g. risk of poor choice of target market (may be generally influenced/skewed by the model) [½]
E.g. risk of increased lapse rate if marketing target customers unlikely to renew [½]
and consequently that expenses increase due to lower % of renewing business on the book [½]
leading to lower profits [½]

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There may be data protection issues if customer data is being used without the company knowing/understanding how it is being used. [½]
The package may have been designed to produce models for other purposes and it isn't appropriate to use it as the marketing team have used it. [½]
Overall company strategy may be adversely influenced by incorrect or misinterpreted output from the model fed through to management [½]
E.g. may affect classes of business written if model outputs indicate very low or high retention rates are likely for certain classes [½]
(Other valid points - maximum 1 mark)

[Marks available 9, maximum 3]

(vi)
Speak to the vendor/software producer [½]
Request that they provide a user manual [½]
Or the developers within the marketing team may be able to produce a user manual and other technical model documentation [½]
Get training from the vendors/software producer [½]
Compare the model output with that from the Pricing Actuary [½]
Test the model predictions on actual out-of-sample data [½]
Plot a lift curve / other model assessment metrics [½]
Run tests on the model to see how changing inputs changes the outputs [½]
to help understand how it works [½]
and that there are no unintended consequences, e.g. to vulnerable customers [½]
Introduce a requirement that all new models and model software must undergo approval from technical experts before being used [1]
including tighter controls on data reconciliation checks and understanding of any model weaknesses/limitations [½]
Require that all new models are checked for compliance with data protection laws and any other applicable legislation / regulations [½]
Do a pilot run and validate results before "live" use of the model [1]
Continue to monitor effects of using the model after it is live [½]
Improve succession planning within the company, to reduce key person risk
For example, ensure that multiple team members are trained in how to use the model [½]
Confirm that the input data is the same within the model used by the marketing team as the pricing model used [½]
(Other valid points - maximum 1 mark)

[Marks available 9½, maximum 3]
[Total 16]

Part (i) was mostly answered correctly.

A few candidates missed out part (ii) but most gave fully correct proofs. A few did not show sufficient steps to demonstrate understanding.

Part (iii) was generally well attempted. Some did not give enough detail for 5 marks. Better answers considered age, premium ratio and the interaction in turn.

Part (iv) was well attempted with many fully correct answers. A common error was to omit either the base or the interaction term.

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Answers to part (v) varied. Many responses explained that the model might be wrong but did not consider many consequences (i.e. risks) of this.

Part (vi) was well attempted but few answers gave a sufficient number of valid points to score well.

Q9

(i)

Reasons:

Lack of understanding by businesses of the probability of a cyber event/attack [½]
And/or unaware of the potential cost to the business of a cyber-attack / cyber risks deemed within their risk appetite [½]
The intangible nature of cyber risk makes it difficult for potential purchasers to understand the value of cyber insurance [½]
Brokers themselves may not understand cyber risk and are therefore not able to articulate that there is an insurance product for it [½]
Lack of incentive for broker to sell cyber insurance, e.g. commission structure, or other problems with relationship [½]
Insurance company has not marketed adequately [½]
Businesses believe that their existing insurance already covers this risk [½]
Unaware of the cover provided by cyber insurance [½]
May have put their own IT solutions in place to protect themselves. [½]
Premium charged is too high compared to competitors [½]
The small businesses are prioritising their budget on areas other than insurance / not seen as value for money [½]
E.g. on improving cyber resilience [½]
Cover provided is not suitable [½]
And/or competitors offering more attractive cyber insurance products e.g. fewer exclusions [½]
Underwriting has tightened or is stricter than competitors [½]
Lack of trust in insurers (e.g. as a result of the coronavirus pandemic) [½]
Low prevalence of cyber events in recent years [½]
Other competitors have entered the market over the last two years [½]
Customers would prefer to use a larger insurance company, with a more well-known brand name and greater diversification [½]
Weaknesses of distribution channel (e.g. lack of an appropriate sales channel to sell this specialist product) [½]
Poor reviews/customer experience/claims servicing in the last 2 years leading to bad reputation and deterring new buyers. [½]
(*Other valid points - maximum 1 mark)*

[Marks available 10½, maximum 4]

(ii)

Risks:

Pooling of risks may be less applicable for cyber [½]
Pricing this product can be difficult / risk of mispricing [½]
for the following reasons:

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Sparse data [½]
Past events might go unreported or undetected [½]
Constantly changing business environment [½]
Rapid evolution of information technology [½]
Lack of experience/expertise given only writing for 2 years [½]

Evolving and difficult to predict threat landscape [½]
Fast paced and complex regulation [½]
Accumulation risk as a single cyber-attack could impact large numbers of customers [½]
Risk of more accumulations than expected [½]
Cyber premiums may be unable to absorb losses from a systemic event / aggregation of risk, or risk of insolvency if insufficient capital [½]
Insurer could struggle to attract additional capital needed to write this business [½]
Capital requirements may be higher than expected, leading to lower than expected free reserves available for investment, leading to lower than expected investment income [½]
Risk that claim frequency and/or severity is higher than expected [½]
e.g. Ransomware attacks are both high impact and high probability risks [½]
Expenses may be higher than expected [½]
e.g. need to employ specialists to handle cyber claims, provide mitigation advice to insureds, etc. [½]
Competition may result in premiums being reduced [½]
Reinsurance costs may be higher than expected [½]
or reinsurance may not be available [½]
Moral hazard by insureds, may take less cyber security precautions than they otherwise would if they did not have cyber insurance [½]
Disputes could lead to reputational damage, which could reduce business volumes [½]
Fraudulent claims may be difficult to detect [½]
Risk that premiums may be set too high to attract sufficient volumes [½]
Risk that book may have high percentage of companies with poor IT security compared to competitors, due to poor rating / underwriting [½]
Risk of court decisions broadening intended coverage or removing exclusions
e.g. cyber-attacks carried out by a nation state [½]
Risk that claims inflation is higher than expected [½]
(Other valid points -maximum 1 mark)

[Marks available 14, maximum 6]

(iii)
Reasons:
A cyber cat is most likely to become apparent over several weeks or months of accumulating claims occurrence [1]
may not be easily distinguishable from "normal" claims [1]
would also need to consider the impact of "silent cyber" on other lines of business [½]
Proving what happened and who did it is very difficult [1]
May be difficult to identify all claims caused by the same piece of malware [1]
Difficult to identify how much of a financial loss is "large" enough to be classified as a cyber catastrophe [½]
Relatively new product, so there's a lack of historical experience on "cyber catastrophes" [½]
The cat event does not have a location in the same way as traditional cat events, so it may be harder to identify that multiple losses result from the same event [½]

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Also may be more hidden than traditional cat events, which are very visible and easily observable [½]
and some firms affected by an event may not disclose that they have been affected for fear of reputational damage [½]
Claims very far apart in time (e.g. over a year apart) could relate to the same event, e.g. if malware is designed to 'hide' in a system [½]
(Other valid points - maximum 1 mark)

[Marks available 7½, maximum 3]

(iv)
Normal volatility in claims observations cannot be extrapolated to estimate the catastrophe tail risk [½]
however a return period may be assigned based on another line of business (e.g. nat cat on property lines) [½]
The underlying cause of a cyber cat is likely to increase the frequency and severity of claims [½]
Start with the frequency and severity distribution of "normal" claims [½]
Run several scenarios of extreme but plausible circumstances [½]
to generate an increased frequency and severity distribution [½]
get data/expertise from a broker/other [½]
use a vendor model if one exists [½]

[Marks available 4, maximum 3]

(v)
Steps:
Populate the inventory module by generating a portfolio of policies [½]
that represent the likely mix of business that they expect to write [½]
Run the portfolio through the model to simulate cyber cat event losses [1]
Populate the financial analysis module, applying the contract terms (excesses and limits) [½]
Derive the distribution of the annual cyber cat losses [1]
This can then be used to derive the expected annual loss (AAL) [½]
The AAL would give the cyber risk element of the risk premium [1]
If any parameters are needed to run the model, seek guidance on what to use and/or assess sensitivity of output to these parameters [½]
Alternatively the loss event distributions output by the model could be used in a stochastic frequency-severity model to simulate cat loss experience [1]
(Other valid points - maximum 1 mark)

[Marks available 6½, maximum 5]
[Total 21]

Part (i) was mostly answered well, and it was good to see that consideration was given to the fact that the cover was for small businesses.

Part (ii) was well attempted but only a few responses had enough different points to do very well.

Answers and success varied widely in part (iii). A common weakness in answers was to talk about cyber insurance in general rather than cyber catastrophe in particular.

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Part (iv) was not answered well in most cases.

Part (v) was generally well attempted but it appears that time was spent describing all 5 cat model modules, rather than focussing only on the steps the Actuary would take.

[Paper Total 100]

END OF EXAMINERS' REPORT

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