EXAMINERS' REPORT

November 2016 examinations

Subject F103 — *General Insurance*
Fellowship Principles

INTRODUCTION

The attached report has been prepared by the subject's Principle Examiner. General comments are provided on the performance of candidates on each question. The solutions provided are an indication of the points sought by the examiners, and should not be taken as model solutions.

QUESTION 1

i. Relative advantages of B over A:

- Z, being well-established, will provide a more secure reinsurance arrangement than Y.
- Brokers are likely to have more confidence in X if it reinsures through Z, which should help build market share.
- A may not provide sufficient diversification, e.g. due to accumulations caused by weather risks if X & Y have policyholders in the same city.
- X will be taking on exposure to the risks accepted by Y, which may be of lower quality (and profitability) than its own business.
- X will need to spend time (and thus money) to understand Y's business, e.g. its underwriting, contract terms, Y's financial security, etc.
- A may result in the disclosure of market knowledge to Y (a competitor).
- Z would be able to provide more technical assistance to X (e.g. data, pricing, etc.) than could be gained through collaboration with the recently-established Y.
- B could also provide other benefits such as financial assistance, which are not likely to be available through reciprocity with a recently-established insurer.
- Surplus will give X much more flexibility in terms of the size/variability of the risks it retains. This is of particular relevance for commercial property insurance where the sizes of the risks can be quite varied.

ii. (a) To retain as little risk as possible all 5 lines should be used.
This will leave X with a retention of \$1.5m (\$9m/6) which satisfies the minimum retention restriction.
Recovery = 5/6 × \$12m = \$10m

(b) X cannot use all 5 lines of the cover as this would leave X with a retention of \$0.5m EML (\$3m/6).
Hence the retention is \$1m and 2/3 of the risk is reinsured.
Hence recovery = 2/3 × 3.6m = \$2.4m

iii. (c) Balance of claim after Surplus = \$12m – \$10m = \$2m
XL recovery = 0.8 × (\$2m – \$1m × ((c)/110)) = \$0.88m
Hence \$0.9m = \$1m × ((c)/110), and so (c) = 99

(d) Balance of claim after Surplus = \$3.6m – \$2.4m = \$1.2m
As there is no XL recover we know that:
0.8 × (\$1.2m – \$1m × ((d)/110)) ≤ 0
Hence (d) ≥ 132

This was a straightforward question, and was well answered by the better prepared candidates.

Marks were lost in part (i) when insufficient detail was provided. Many candidates scored full marks (or close to full marks) for the calculations (in particular part (ii)).

QUESTION 2

i. When pricing, it is important that we monitor the progress of existing experience as it develops, in order to assess the need for a review. Thus, one effect of inadequate data is that we might make a wrong decision on the need for a review and rate to be charged.

When we carry out the actual projections of the new rating requirements, inadequate data may distort the calculations. This may be due to errors in:

- the apparent size of the business in force, and its value expressed in exposure units and premium;
- the apparent claims experience and its trends, on which the projected future costs are being based.

Moreover, the errors may distort the true distribution of the business between risk groups. This could have consequences if we decided to adopt a differential rating increase for each risk group. It could also affect the marketing strategy if certain risk groups appeared to be more attractive risks than they actually are.

If we adopt a deficient set of rates as a result of faulty data, the insurer might:

- suffer underwriting losses if rates are too low;
- suffer loss of market share if rates are too high;
- attract undesirable risks, causing deterioration in underwriting experience if rates for such risks are too low.

ii. To price policies appropriately the company needs data that are reliable and relevant.

There are two primary sources of data, internal and external data sources.

The insurer will have experience data that will be appropriate to pricing personal lines property insurance in Country A. If the perils and risk characteristics of personal lines property insurance in Country B are similar to Country A, then the internal data the company has may be relevant for pricing purposes subject to suitable loadings and adjustments for risks associated directly with Country B.

However, where the insurer has insufficient or unsuitable internal data, external data will need to be used. One factor to consider when using external data is how reliable the data source is.

External data may take the form of aggregate market statistics. Alternatively, we may obtain data from third parties, such as reinsurers or brokers. The reinsurer, which is providing reinsurance cover for the product, may be prepared to supply data and other information about the market as a whole, without giving away competitive information of any one of their cedants.

For data obtained from external sources or from third parties, we should compare with the corresponding details for the policies the insurer intends to write, as far as possible:

- the terms of policy cover offered;
- levels of risk underwritten;
- the loadings included for expenses and profit in the premium;
- socio-economic differences.

We should establish the time period of the data so that we can make an appropriate allowance for inflation. It will be difficult to obtain much of this detail for many products.

The insurer could also investigate the feasibility of purchasing an existing insurer that sells personal lines property insurance in Country B. This may give them direct access to experience data in Country B.

iii. Take a prudent view of future experience and reflect this in the pricing structure. For example, conservative assumptions in models, explicit loadings for uncertainty in pricing models and fully loaded expenses.

Consider only writing a subset of risks/perils until actual experience becomes available.

Consider only accepting liability covers with low limits & exposures until actual experience becomes available.

Use more reinsurance, reducing the retention to reduce risk.

Examine the sensitivity of the pricing models to assumptions, particularly looking at whether it drives a decision on whether to write business or not.

Carry out a "what if" analysis of a draft rating structure and set of decline rules to see what business would be won at what price comparing output from pricing models to the price charge by other insurers in the market.

Put in place monitoring of key statistics, such as volumes, premiums, mix of business and cause of claims to spot possible problems early.

Ensure the company can change rates quickly with renewals every 6 months rather than annual reviews.

Consider selling through brokers and using a profit sharing arrangement so that the brokers have a financial interest in the success of the business.

Consider not selling insurance policies until better quality data is available to price.

Part (i) was fairly well answered by the majority of candidates. However, most failed to give enough points or explain their points in order to score well on the question.

Part (ii) was straightforward, and marks were reasonable. A number of candidates focused on the quality of data from different sources rather than discuss the data sources.

Part (iii) was answered poorly by most candidates. Generally candidates failed to give enough points, and a number of candidates simply did not answer the question asked.

QUESTION 3

i. Economic capital is the amount of capital that a provider determines is appropriate to hold given its assets, its liabilities, and its business objectives.

The current XL treaties will protect the insurer against large individual accident losses as well as catastrophes that may lead to an accumulation of losses from a single event.

If the excess points increase the volatility / uncertainty of the financial result will increase and hence the capital requirement will increase as the company will retain a larger share of large loss events.

In order to understand the impact on capital requirements, the actuary will need to investigate the additional volatility caused by the proposed increased retention. This can be done by:

- Analysing the volatility in frequency and severity of large individual historic losses suffered by the insurer. This can be done using several years' past data. Historic losses will be inflated and projected to ultimate (IBNR allowance).

  The actuary could include in the analysis all losses greater than a threshold which, in current monetary terms, might have exceeded the current excess point. Using the burning cost per year or a stochastic frequency-severity model the actuary can then calculate both the mean loss and 99.5^{th} percentile of losses to its own net retention on both the historic and the new proposed retention.

- Analysing the frequency and severity distributions of accumulation type events, including natural catastrophes such as hail and storm, as well as man-made catastrophic events such as a fire at a commercial property and multiple vehicle loss events (e.g. pile ups).

It is important that the change in estimate exposure (i.e. if the company intends to grow the number of vehicles insured) also be included in the adjustment of historic data.

The actuary can also calculate the direct impact on the capital requirements of changing the excess points by using their internal capital model. The internal capital model will model the main elements of the business, including premiums, expenses, claims, reinsurance and investment income (amongst other things). The model will estimate the experience for each of these elements in the future time period and hence can be used to set the economic capital on a 99.5^{th} percentile value-at-risk. Considering different excess points for its Risk Excess of Loss and Catastrophe Excess of Loss treaties as inputs within the model, the actuary will be able to directly compare the impact on the economic capital requirements.

ii. Other investigations:

- Expected impact on profit, e.g. reinsurance premium payable vs expected recoveries.
- Analysis of alternate structures such as QS vs XOL.
- Analysis of reinsurance commission structures, overriders and profit commission.

The answers to this question were very disappointing. For part (i), very few candidates managed to identify that increasing the excess points would result in an increase in the volatility / uncertainty of the financial result for the insurer which would mean that the capital requirement would increase. As such they failed to specify the analysis that the actuary would undertake. Most candidates showed their lack of understanding by simply regurgitating how to fit and run a stochastic model.

For part (ii) the majority of candidates failed to mention investigations that would lead to a decision regarding an optimal reinsurance structure but focused on analyses relating to investment strategy, reserves, mix of business and experience analysis without outlining how these would assist the company in formulating an optimal reinsurance structure.

QUESTION 4

i. Perils include:

- Damage to the project.
- Destruction.
- Design defects.
- Discovery of construction faults.
- Faulty parts.
- Failure to finish the project, or finish on time.

ii. UPR calculation:

Policy A UPR (31.12.2014) = 8/10 × R7m = R5.6m
Policy A UPR (31.12.2015) = 7/10 × R7m = R4.9m

Policy B UPR (31.12.2014) = (100% - 2% × 3 months) × R20m = R18.8m
Policy B UPR (31.12.2015) = (100% - 2% × 12 months - 1.5% × 3 months) × R20m
= R14.3m

Policy C UPR (31.12.2014) = 0 (policy had not yet been written)
Policy C UPR (31.12.2015) = (100% - 1/3% × (10 × 11 / 2)) × R15m
= R12.25m

Total Insurer UPR (31.12.2014) = R24.4m
Total Insurer UPR (31.12.2015) = R31.45m

iii. Premium written = R15m
+ UPR bf = R24.4m
- UPR cf = R31.45m
Premiums Earned = R7.95m

IBNR bf = 85% × [1/120 × R7m + 2/100 × R20m] = R0.3896m
IBNR cf = 85% × [1/120 × R7m + 1.5/100 × R20m + 1/3% × 10 × R15m] = R0.7296m

Claims paid = 10% × R4m = R0.4m
+ OS Claim reserves cf = 90% × R4m +IBNR cf = R4.3296m
- OS Claim reserves bf = IBNR bf = R0.3896m
Claims incurred = R4.340m

Expenses paid = 15% × R15m + 0.5m = R2.75m

DAC cf = 10% × (R4.9m + R12.25m) + 12% × (R14.3m) = R3.431
- DAC bf = 10% × (R5.6m) + 12% × (R18.8m) = R2.816
Increase in DAC = R0.615m

Investment income = 8% × ½ × (UPR bf + UPR cf + OS Claims bf + OS Claims cf)
= 8% × ½ × (R24.4m + R31.45m + R0.3896m + R5.2296m)
= R2.459m

Revenue Account:

	R millions
Premiums Earned	7.950
- Claims incurred	-4.340
- Expenses paid	-2.750
+ Increase in DAC	0.615
	1.475
+ Investment income	2.459
Insurance profit	3.934

iv. Profit margin = insurance profit / earned premiums = 3.934/7.95= 49.5%

Comments:

- This ratio is very high – key contributors are the high investment income level (mainly due to high UPR level, reflecting the long-term nature of this business) and the low claims ratio (claims incurred/premiums earned=55%).
- IBNR is assumed to arise only from the last prior month, however if claims can reasonably arise from earlier months, IBNR is underestimated.
- As this insurer is new, and due to the nature of the business, IBNR cannot be estimated from past claims, so there is considerable risk of error.
- The profit margin is very dependent on the assumed incidence of risk, which may be incorrect.
- This class of business is risky (considerable unknowns, large claims) which might justify high profit margins in premiums.
- Risk-based capital requirements would be high for such a risky class, hence high profit margins may be needed to provide shareholders an acceptable return on this capital.
- The high margin could also be due to weak / no competition for this business, or possibly due to the insurance cycle (and premiums hardening).

This question was answered very poorly by the majority of candidates, who showed a very weak understanding of the most basic concepts.

Part (i) was straightforward bookwork, which was answered fairly well. Part (ii) was a straightforward UPR calculation, yet very few candidates got this part completely right, in particular the UPR for Policy C where the risk was increasing over the term – most candidates either got tripped up by the sum of an increasing arithmetic series, or simply gave up at this point.

Part (iii) was very poorly answered with most candidates ignoring much of the information provided in the question – IBNR in totality or IBNR b/f was either ignored by many candidates or incorrectly calculated, DAC was often based on total acquisition costs despite the question specifying that this was not allowed and commission not being regarded as part of "total acquisition costs" were just some of the common errors.

Part (iv) was answered reasonably well by those who attempted it.

QUESTION 5

i. The policyholder must have an interest in the risk being insured, to distinguish between insurance and gambling.
We can assume that there is an interest in the quality of the software being produced as CSC will not want to risk its reputation.

The risk must be of a financial and reasonably quantifiable nature.
The risk is financial in nature, but it will be difficult to estimate at outset as there is no past experience of such products.

Individual risk events should be independent of each other.
In this case there will most likely not be independence, as an error in the software could result in losses to many users of the product.

The amount payable by the insurance policy in the event of a claim must bear some relationship to the financial loss incurred. There should be an overall limit on the liability undertaken by the insurer.
This can be achieved by imposing limits on the extent of the insurance cover, despite the underlying loss potentially being unlimited.

The probability of the event should be relatively small. In other words, an event that is nearly certain to occur is not conducive to insurance.
It would be hoped that the likelihood of claim would be small, however moral hazard should be considered.

Large numbers of similar risks should be pooled to reduce the variance of the average claim size and hence achieve more certainty.
As this will be the only such product initially, claims variability will be expected to be high.

Moral hazards should be eliminated as far as possible because they are difficult to quantify, result in selection against the insurer and lead to unfairness in treatment between one policyholder and another.
It is not likely that insurance will cause CSC (or its staff) to behave differently. However, users of the product may try to sue excessively for damages (particularly following the first such successful claim from an individual).

There should be sufficient existing statistical data/information to enable the insurer to estimate the extent of the risk and its likelihood of occurrence.
Initially there will be no such data, and sources of similar insurance data may be hard to find.

ii. A claims-made basis is the most likely since claims linked to malfunction of certain software may occur long after the period of exposure.

Also the customer makes the claim, but it is the company who is insured so typical concerns around when claims are reported are not important. Alternatively, a losses occurring basis is possible when related claims to sales in a given year.

iii. An appropriate exposure measure may be the forecast volume of sales in a particularly year, with an adjustment premium payable for the actual sales volumes (by turnover or number of units) experienced.

Rating factors could include:

- The nature of the robots produced, as their complexity and size could lead to different levels of risk.
- The domestic chores catered for, as some may lead to more inherent risks than others.
- The distribution channel and target market for the robotic product. Less sophisticated users may be at more risk.
- The geographical region where the product is sold will have an impact in terms of propensity to claim, e.g. US exposure typical has a higher claim frequency and the potential for larger settlements due to punitive court awards.
- Some reliance may be placed on the quality of CSC's other products, as reputational damage in one area may result in increased claims in another.
- How often software updates are to be sent sent to users (can robots be updated online?) will be relevant.
- Although there is no insurance data on the performance of the robots, there may be some qualitative data of tests and the general performance of the software which can be used.
- For product liability type risks each policy will be underwritten individually, and the underwriter will need to assess the risks arising from a policy subjectively.

Overall performance on this question was reasonable. Many candidates got most of the principles of insurability, although fewer considered them in relation to the question. Most candidates correctly implied that the insurance will be bought by the company - but very few listed rating factors that were appropriate to this case, tending to list rating factors applicable to the company's clients.

QUESTION 6

i. Moral hazard is the risk that an insured may behave in a less risk-averse manner when they are insured.

In this case, the insured party is the bank, and the risk is that it accepts students who are more likely to default knowing that it is protected against this risk.

Weaker students (academically) may be more likely to default, but the requirement for minimum matric grades would prevent the bank from lending to overly weak students. However, the bank may lower these requirements.

The bank may, however, be less strict on some of its other underwriting factors which affect the quality of the loan, e.g.

- University attended (impacting quality of education and likelihood of finding work);
- Course studied (impacting likelihood of finding work);

- Matric examinations written (impacting likelihood of completing degree); etc.

ii. The availability of insurance will likely make banks more willing to offer unsecured loans to students, where before they may have required security.

This should have the effect of allowing more students to attend university, which will have a positive effect on society.

iii. There is a risk that interest rates rise, resulting in more students not being able to afford repayments on loans and hence an increase in claims.

Similarly, if there is a general economic recession, this will result in job cuts and more defaults from past students who are working to pay back their loans.

There is a risk that school standards drop, resulting in poorer students meeting the minimum academic criteria to qualify for a loan. If university standards are constant, a number of these students will fail and/or possibly find it harder to obtain a decent job, hence more defaults and higher claims.

Similarly, there is a risk that the government pushes to have loans given to more students (e.g. by forcing banks to reduce barriers to obtaining loans), resulting in more academically poor students taking out loans and hence defaulting. The insurer may be able to price this in overtime, but existing premiums will be too low. Also, if premiums are increased, this may decrease demand for the insurance

There is a risk that demand is significantly reduced making it difficult to cover fixed costs. For example, if fewer students take out loans from banks, say due to the government providing cheap loans; or if banks make a move to retain the risk in-house, say if they have built up enough experience over time to price unsecured loans.

Depending on the political stability within the country, student movements may push for large groups of students to not pay back loans, effectively resulting in defaults, and hence claims.

Increased competition. As there is unlikely to be a vastly increasing number of students attending university each year, and hence potentially taking out loans, the market is rather limited. A competitor under-cutting premiums could take a large share of this limited market, reducing volumes and hence profits and ability to cover fixed costs.

Reputational risk. Especially if premium rates are considered "too high" and "unnecessary" by students, i.e. the insurer is seen as "profiteering" from poor students.

iv. *Should the model be updated?*

A company's internal capital model estimates the capital requirement by estimating the worst potential outcome of the business over a certain time horizon with given confidence level e.g. 1 in 200 VaR over a one-year time horizon.

To estimate this "bad year", the model should allow for variability in the drivers of the profitability of the business, including the interest rate in this case, as an increase in interest rates will likely result in an increase in defaults.

Thus, an increase in interest rates, while perhaps not the most likely scenario (the mode), should be within the possible outcomes produced by the model.

If this is the case, it should not be necessary to change the model parameters.

Though, the increase in interest rates may change the future outlook on future interest rates and future variability. If this is the case, then the model parameters will need to be updated.

Updating the model if necessary

In updating economic scenarios, such as the interest rate, it is important that all economic parameters are modelled consistently. For this purpose, an economic scenario generator is usually used. For example, the return that the insurance company earns on its investment assets should be consistent with (not necessarily equal to) the interest rate on student loans.

The rest of the model should automatically adjust to cater for the increased interest rate as even before the unexpected increase, the model should have been able to handle scenarios with randomly generated high interest rates.

But particular attention should be paid to the relationship between defaults on student loans and higher defaults, which may not be linear.

Furthermore, the higher interest rate may reduce economic activity over time and increase job cuts, further increasing defaults on loans. This should be catered for in models with longer time horizons.

In part (i) most candidates specified that moral hazard arises when the presence of insurance results in a change in policyholder behaviour, but a number of candidates did not specify that the change was adverse and usually linked to greater risk taking.
Many students gave poor underwriting by the bank as an example, but did not specify that this only applied to underwriting factors other than matric mark, for which an automatic premium adjustment applied.

Part (ii) was fairly straightforward and most candidates gave a reasonable argument. Some candidates failed to mention the effect on society and only spoke about individual students, banks and insurance companies.

In part (iii) the better candidates focussed on risks that were highly relevant to the scenario. Minor credit was given for general risks.

In part (iv) many candidates failed to grapple with whether the model should indeed be updated, failing to recognise that an "unexpected" event may be within the distribution of outcomes considered by the capital model, though unlikely.
Most candidates recognised the effect that interest rates would have on claims and the concurrent effect on the investments of the insurer.
The second part of the question was better answered, though a number of candidates made the mistake of listing the steps involved in building a stochastic model (or subtle variations thereof), when a more specific and considered answer was required.

QUESTION 7

i. The net of retrocession IBNR reserves based on the actuary's selected methodology are:

(Amounts in R'000s)

Accident Year	*Selected approach*	*Gross Ultimate Claims*	*Gross Incurred Claims*	*Gross UPR*	*Gross IBNR*	*Net IBNR*
2011	Paid	32 936	33 243	-	-307	-46
2012	Paid	60 335	59 094	-	1 241	186
2013	Paid	52 936	51 750	-	1 186	237
2014	Paid	70 756	63 453	-	7 303	2 191
2015	BF Paid	114 681	48 879	54 080	11 721	5 275
Total IBNR at 31 December 2015					21 144	7 843

Assumptions:

- The UPR is estimated as 50% of the 2015 underwriting year's written premium.
- The paid claim triangle is completely run-off and no tail factor is used.
- The Basic Chain Ladder assumes that future inflation is a weighted average of past inflation.
- The amount of claims developed for each accident period is a constant proportion of the ultimate claims for a given development period.
- The underwriters' loss ratio is appropriate to use.

ii. Analysis of reserving methodology and assumptions:

- The actuary uses the BF method to add stability to less developed underwriting years. However, the 75% is arbitrary and may not always lead to the most appropriate reserving methodology.
- The actuary uses paid data to estimate an IBNR which may be more homogenous than incurred claims data which is subject to numerous insurers' case estimation philosophies. However, the actuary should consider alternative reserving methodologies e.g. BCL incurred or loss ratio methods when selecting IBNR reserves.

- The assumption made that risk is earned uniformly across the underlying policies may not be appropriate. It may also not be the case that policies are sold on average half way through the year.
- The assumed combined ratio is an estimate and introduces additional uncertainty in the calculation of IBNR reserves.
- The actuary assumes that claims are fully run-off after 4 years which may not be the case. A tail factor may be necessary to avoid understating the IBNR.
- The actuary uses the underwriter's Loss Ratios without any adjustments. This may not be appropriate. There is strong evidence that the underwriters' Loss Ratios are too optimistic i.e. compare BCL ultimate Loss Ratios to underwriters' Loss Ratios. Using the underwriters' Loss Ratios will likely lead to an underestimation of IBNR.
- The combined ratio is 60% which is lower than the underwriter's loss ratio of 65%. The combined ratio is the loss ratio plus the expense ratio and so should be higher than the combined ratio. There is thus some evidence that the loss ratio is understated which will lead to an insufficient level of IBNR.
- The actuary could consider alternative reserving methodologies for example the Inflation Adjusted Chain Ladder or the Basic Chain Ladder based on incurred claim data.
- There has been rapid growth in the book which may result in a changing mix of business. This may invalidate the assumptions of the Basic Chain Ladder method.

iii. The additional data challenges are:

Longer reporting delays:

- Quarterly reporting of claims and premium information means that reinsurers are typically notified a quarter later than insurers.
- For excess covers it can take time for insurers to recognise that a loss is large enough to be reported to its reinsurers.
- The Reporting process, e.g. agreeing on a claim estimate, can introduce additional delays.

Greater tendency for claims to development upwards:

- Greater tendency for claims to develop upwards especially on liability classes where the claim can be disputed for a number of years.
- This follows as longer delays to settlement mean that there is more time for social and economic inflation to affect the final settled claim amount.

Greater heterogeneity:

- Reinsurers' data are generally more heterogeneous than insurers due to greater geographic spread, a wider range of terms and conditions, and various case estimation philosophies of the underlying insurers.

Sparse data:

- For high excess non-proportional business there may be very few claims and thus little data available to populate claims triangles.

Reduced applicability of benchmarks:

- Industry-wide benchmarks may be less appropriate due to the heterogeneity of the data.

Data systems and constraints:

- Information received is less detailed compared to information insurers receive.
- This is more of an issue for proportional reinsurance where information is reported on an aggregate basis.
- Additional difficulties when needing to split data into accident year format for financial reporting.

Errors in insurers' data:

- Any errors in the primary insurers data will automatically affect the reinsurer.

Part (i) was poorly answered. This question was challenging and required a firm understanding of the Chain Ladder and Bornhuetter-Ferguson methods. A number of candidates produced an estimate of the claims reserves i.e. OCR plus IBNR, and not the IBNR. In order to calculate an IBNR the incurred claims to date needs to be subtracted from the ultimate claims. Stating assumptions made in the calculation was an easy way to score marks, without doing any calculations. Some candidates applied the Bornhuetter-Ferguson method to incurred claims data and not to paid claims data as specified in the question.

Overall candidates generally performed well in part (ii) with some candidates scoring full marks. This was an application question requiring candidates to apply their knowledge of the different actuarial method's strengths and weaknesses. Thus candidates who analysed the pros and cons of the actuary's methodology generally scored well.

Part (iii) was a book work question with a number of candidates scoring full marks.

END OF EXAMINERS' REPORT

