EXAMINATION

November 2010 (am)

Subject F103 — General Insurance Principles

EXAMINER'S REPORT

QUESTION 1

This was one of the better answered questions in the paper yielding a relatively high average mark. This is somewhat expected since the question was based largely on bookwork. Interestingly, this question was a very strong predictor of overall performance in the paper.

Many candidates did not score as well as they could have in part 1 by not restricting their answers to claims related information. Part 2 saw the poorest performance from candidates but it was only worth 2 marks.

The most successful candidates on part 3 employed a looser link between the problems associated with the delay and the mitigation techniques rather than employing a very formulaic approach of stating one mitigation for every problem.

There were a very wide range of responses presented for part 4. In each case, credit was awarded for all reasonable factors listed.

Suggested solution:

(i)

- Date claim occurred
- Date claim notified
- Dates of payments
- Amounts of payments
- Date(s) of settlement
- Date(s) of reopened
- Estimates of the outstanding amounts
- Estimates of IBNRs per claim (but there are practical limits to using this)
- Rating factor details (at the time the claim occurred)
- Cause of claim
- Type of peril
- Claim number

(ii)

- The length of time that can elapse before sufficient claims have been notified on which to base a rating exercise
- Delays in processing and analysing the claims experience
- The time taken in assessing and receiving agreement that the premium rates can be changed
- The administrative time taken to implement a rate change
- Time taken to receive approval from a regulatory body (necessary in some countries)

(iii)

(a)

Experience in the intermediate period may turn out to be different to that expected because

- Claims trends not as expected
- Claims inflation not as expected
- Commission rates have changed
- Expense levels have changed
- Volume assumptions have proved inaccurate
- Competition and market has changed
- Investment returns have changed
- Changes in legislation and court awards
- Cover changes in product
- Changes in risk levels

(b)

- scenario test the profitability so the range of possible outcomes is understood
- use the most up to date data that is available and developed enough, use different periods for different perils
- consider competitors likely reaction to any rating changes that are in the pipeline (i.e. where the decision has been taken but the rates are not in the market)
- analyse the results of previous rating changes to try and assess the likely changes in volumes
- research and be aware of likely changes to legislation

(iv)

- Expenses
  - fixed
  - variable
- Loading
  - per policy
  - proportional to premium
  - per claim
  - proportional to claims
- Commission if applicable
- Investment return both income and capital growth
- Reinsurance costs i.e. the net cost to the insurer of buying reinsurance
- Profit margin required by the company
- Discounts available e.g. loyalty discounts
- Payment method (admin fee for monthly payers)
- Competitive analysis
- Required growth of business volumes by number of policies and premium and hence standing in the market in respect of market share

QUESTION 2

Suggested solution:

$$E[X] = e^{\mu+\frac{1}{2}\sigma^2} = e^4 = 54.59815003$$
$$Var(X) = e^{2\mu+\sigma^2}(e^2-1) = e^6(e^2-1) = 2577.529194$$
$$E[N] = Var(N) = 5$$

Let $S_i = X_{i1} + X_{i2} + X_{in}$ denote the aggregate claims for individual policy *i*.

$$E[S] = E[N]E[X] = 272.9907502$$
$$Var(S) = E[N]Var(X) + Var(N)(E[C])^2 = 27792.43591$$

Let $T = S_1 + S_2 + S_{5000}$ denote the total aggregate claims for the portfolio.

$$E[T] = \sum_{i=1}^{5000} E[S_i] = 5000E[S] = 1364953.751$$

Assuming that the policies operate independently of one another:

$$Var(T) = Var(\sum_{i=1}^{5000} S_i) = \sum_{i=1}^{5000} Var(S_i) = 5000Var(S) = 138962179.6$$

Assume that the distribution of the random variable *T* may be approximated by a Normal distribution with mean and variance as above, i.e. *T* *N(E[T], Var(T))).*

Let *P* denote the premium to be charged for each policy.

$$P(5000P - T > 1000000) = 0.99$$
$$\Rightarrow P(T < 5000P - 1000000) = 0.99$$
$$\Rightarrow P(Z < \frac{5000P - E[T] - 1000000}{\sqrt{Var(T)}} = 0.99$$
$$\Rightarrow \frac{5000P - E[T] - 1000000}{\sqrt{Var(T)}} = 2.326$$
$$\Rightarrow 5000P = 2392373.256$$
$$\Rightarrow P = 478.47$$

QUESTION 3

This question required the student to work through the different types of reinsurance and suggest how each may be applied to the given scenario. The second part of the question was a calculation question.

The first part of the question was generally well-answered in that students could identify the reinsurance types which would be needed. However, many students lost marks because the explanation of how the reinsurance would be used was vague.

The second part of the question was easy marks for those students who understood how a stop loss and quota share treaty operated. Some students received almost no marks because they didn't understand the term "loss ratio". Method marks were awarded where careless calculation errors were made.

Suggested solution:

(i)

- **Reduce cost of capital**. Reinsurers' exposed to greater variety of classes and greater geographical spread, resulting in a relatively lower cost of capital. Thus the reinsurer can pass on this lower cost of capital to the insurer by charging lower reinsurance premiums to the insurer. All reinsurance will serve this purpose, but excess of loss arrangements likely to have the greatest impact on capital requirements.
- **Smooth results** from year to year. Excess of loss reinsurance will prevent large spikes in the loss experience and proportional cover will reduce the magnitude of any variation. This may be valued by shareholders who are risk averse and don't want too much volatility in results.
- **Allow more exposure** to be written. By sharing risk with the reinsurer, the insurer will be able to write more business with the same capital base. This will be useful if the insurer is trying to grow and increase market share (which may be expected from a small insurer). Excess of loss reinsurance will greatly stretch the available capital. Quota share will also allow more business to be written, but the reduction in capital will only be in the same proportion as the quota share (whereas the reduction in capital may be relatively ore significant for excess of loss arrangements).
- **Larger risks** can be written**.** The insurer will be able to accept larger individual risks. Individual excess of loss will protect against large losses, but proportional cover will also allow larger risks to be written. Surplus is common for large properties – this allows the insurer to specify the retention on the risk.
- Design **new products** or refine existing products. The insurer may wish to write more classes of business and the reinsurers' expertise may be helpful in designing the products, setting premiums and understanding the risk inherent in the products. Reinsurers often offer some or all of the following services: pricing, product development, market analysis, feasibility studies, data analysis.

- Protection against **large individual losses**. Risk/individual excess of loss reinsurance will be purchased. Large losses may arise from buildings being flattened during earthquakes or burning down. Motor liability claims also have the potential to be large.
- Protection against **catastrophe losses**. For example, an earthquake causing damage to many buildings in the same area; or a hail storm in rush hour traffic causing damage to a large number of vehicles. This is particularly significant because most of the insurer's business is written in Gauteng. So an earthquake in Gauteng would have a severe impact on the insurer. Catastrophe excess of loss reinsurance.
    - **Facultative reinsurance** would be required when treaty limits are reached or to protect the terms on existing treaties.
    - **Arbitrage**. Reinsurance premiums may be cheaper than cost of cover to the insurer. It would thus be most profitable to reinsure 100% of the business – although in practice the reinsurer would want the insurer to keep some of the risk to reduce the risk of anti-selection by the insurer.
    - **Optimize regulatory capital**

(ii)

Net premium (after QS) = 80m x (1-40%) = R48m

Stop-loss premium = 4% x 48m = R**1.92m**

(iii)

Net premium = 48m

Stop loss cover = 20% loss ratio XS 110% loss ratio

(or 20% of losses in excess of 110% (net) loss ratio)?

= 20% x 48 XS 110% x 48

= 9.6m xs 52.8m

Gross loss = 160m

Net loss = 160 x (1-40%) = R96m

Recovery on stop loss cover = R9.6m (the max)

Retained loss by insurer = 96 – 9.6 = R86.4m

QUESTION 4

The first part of this question required students to explain reserving risk and why it might be present. Most students had no trouble explaining the concept of reserving risk, but they missed out on certain details because they failed to split reserves into its different elements (UPR, OCR, IBNR, IBNER, expenses) and comment on each of these.

The second part of the question required students to compare the use of a deterministic or stochastic model for modelling reserving risk. Students demonstrated an understanding of both types of modelling, but generally did not make their points relevant to the topic of modelling reserving risk. Some students did not even indicate that to estimate reserving risk one needs to have variation in the model and that a stochastic model should be used. Many students did not clearly state their opinion on whether deterministic or stochastic modelling should be used.

Suggested solution:

(i) Reserving risk is the risk that the claims and/or expenses relating to expired business turn out to be greater than reserved for.

This is because reserves are only estimates of what costs are likely to arise.

The reserving risk could arise from :

1) claims which have already been reported turning out to be more than the case estimates set up for them (this could be due to a lack of information at the time of reporting or greater inflation than expected for example, or because the case estimate methodology does not produce accurate estimates – this would be because fixed rand amounts are raised for all notified claims); or
2) claims being reported after the reserves were set up and costing more than the IBNR reserve held; or
3) investment return being less than expected (this would apply if discounting has been used and the investment return has been relied upon to meet future claims).
4) Expenses being higher than expected. For example, court costs when defending a liability claim.
5) Timing of claims settlements being earlier than what was assumed in the discounting of reserves. This less investment return would be earned before claims need to be paid.

(ii) Capital models are used to determine the risk inherent in an insurance company and hence decide on the capital that needs to be held to be available for extreme scenarios where the company experiences bad losses.

A deterministic model will give a best estimate of the reserve that needs to be held by calculating the best estimate of future claims arising from the expired

business. This will not give an indication of the risk/variability in the business and is thus not useful for determining capital requirements.

A stochastic model is more complicated to build, but it will allow for variation in results by using statistical distributions and drawing different random numbers for each of a large number of simulations.

The stochastic model will give an entire distribution of the reserve risk. The potential loss will be seen at each percentile. This will give the insurer an understanding of the expected cost of the reserve runoff and an idea of potential losses in very unfavourable circumstances.

The parameters of the stochastic model will be difficult to determine and there is no way to be sure that they are accurate. Sensitivity testing will be necessary to determine the sensitivity of results to changes in key parameters. An effort should be made to understand the changes in results as the key parameters are changed.

Any reserving method requires historical data (past claim development, notification, payment and run-off data). The more detailed the level of data, the more credibility can be given to the parameters chosen for stochastic reserving.

Note: It is possible to have deterministic reserving techniques but to include reserving risk stochastically in your capital model.

QUESTION 5

This was a relatively easy question that was generally answered well. Points that were missed by most students were:

- *When pricing the product a comparison that should be made is the premium against the reduction in the product price for the waiver of the warranty.*
- *Not many students suggested that by including a deductible or excess it would force the retailer to share in the experience and mitigate the weak claim underwriting.*
- *Not many students suggested that the retailer should provide all the new business and claims administration of the product.*
- *Not many students mentioned that the most appropriate exposure factor was the product price.*
- *Most students mentioned inflation as an issue with this product. This is irrelevant, as inflation has no effect on the amount of the claim.*

Suggested solution:

(i) Risks

- Neither the retailer nor the supplier participates in the loss incurred. This may result in anti-selection behaviour such as:

    - Damaged goods may be sold to customers in order to generate a claim.
    - Suppliers may deliver substandard goods (seconds) as they are no longer required to warrant those goods.
    - Suppliers may no longer apply quality assurance on their goods.
    - Retailer accepts claims too freely. If the customer damaged the goods it would suit the retailer to claim on the insurance and replace the item, thus generating another sale.
- Past not a good guide to the future.
- Nature of goods sold may change in the future.
- Claims administration may be more expensive than expected as the items concerned could be small.

(ii) Reduce risks by:

- Including an excess or deductible for each claim at least equal to the retailer's markup.
- Policy wording to exclude claims that are not due to product defect.
- Change benefit to cost of repair or replacement value, whichever is lower.
- Include margins in premiums (with possible option of profit sharing with retailer).
- Reinsure and use reinsurer's expertise.
- Retailer to provide all administration but subject to audit by insurer.
- Charge an adjustment premium at the end of the insurance period, depending upon the claims' experience.

(iii) Claims will be:

- For relatively small and limited amounts.
- Short tail – probably no more than six months.
- Large number of claims.
- Volatility of total rate of claim not expected to be large.

(iv) Premiums would be determined as follows:

- Sales and claims to be separated into homogeneous groups, by:
    - Different product groups (this may need further research).
    - Supplier.
    - Cost of goods (different bands).
    - Region (to determine socio-economic group of customer).
    - Duration since sale.
- Rating factor = cost of goods (ie. Turnover).
- The rate of claim and the average claim amount would be determined for each category (provided there was sufficient data within each cell).
- IBNR additions may be necessary if recent data not fully exposed.
- Determine the cost savings by retailer from supplier no longer providing warranty. This is necessary to establish upper limit to price.

(v) Reinsurance

- Quota share. Simple to administer. Buys reinsurer's help and alignment of interests. Disadvantage is giving away profit. Profit sharing treaty if rates support it.
- XS of loss. Probably expensive, but accumulations may result from claim rates being dependent on supplier.
- Catastrophe cover is not necessary.

QUESTION 6

This question is straight bookwork, but a significant number of students were not able to answer the question satisfactorily.

(a) This question required the student to consider the implications for the reduction in capacity that would result from a reduction in the number of names. This would reduce the syndicate's ability to accept risk especially if they were large. The majority of students answered this question poorly.

(b) The reinsurance premium to close is based on the calculations that would determine the outstanding claim reserves. For reserving purposes the basis would be conservative. However, for premium calculations the basis would depend upon whether the reinsurer was calculating the premium or the syndicate as each would adopt an approach to server their own purposes. For the premium to be fair it would require the calculation by a party that was independent and without any bias towards one of the parties. Generally not many of the students were alive to this potential for conflict of interest.

Suggested solution:

(i) Funded accounting:

- A method of accounting whereby premiums , claims and associated expenses are related to the underwriting year in which the policies start . The recognition of any underwriting profit is deferred until a subsequent accounting period , but provision is made for losses as soon as they are foreseen .

Three year accounting:

- The usual form of funded accounting, in which the underwriting profits are first recognised at the end of the third accounting year from the start of the underwriting year.

(ii)

(a) Implications:

- Reduced capacity.
- Less business.
- Lower ability to participate in large risks.

- Client's risk is not necessarily increased as capacity is measured on the total of the names' ability to take risk.

(b) Reinsurance to close:

- Liability business has a long tail and the RITC will be a significant financial issue.
- Premium is calculated by determining IBNR.
- Premium will probably be based on conservative assumptions. This will favour the lastest syndicate to the disadvantage of the previous syndicate.
- However the client is both an old syndicate name and the latest syndicate name.
- However given the reduction in capacity this may result in the client being at a greater risk on this business than before, in which case he would prefer to have a lower premium .
- Needs to be determined by someone without interest conflicts. This is a risk area.
- There may be a risk that this reduced capacity is ignored which may increase the risk to the client.

QUESTION 7

(i) *Although this was not a very tough question, many candidates performed poorly. Few students demonstrated an understanding for calculating UPR for monthly policies. Many students failed to back up their calculation methodology with reasonable assumptions.*

Suggested solution:

(All figs shown are in R millions)

As the premiums are paid monthly and assuming that the risk is level over the policy year, the UPR is nil at the beginning and end of the year.

The reinsurance UPR is:
2/12ths of 42 = 7 (2/12 of 48 = 8) at the beginning of the year, and

2/12ths of 66= 11 at the end of the year.

Thus Net Earned premium for the year is:
264 – (66 – 11 + 7) = 202.

DAC at beginning of the year = 2/12ths of 12 = 1.

DAC at the end of the year = 2/12ths of 18 = 3.

DAC: It is not clear to me why 2/12 is being used if policies are written evenly over the year)
Net claims and increase in claim reserves= 106 – 30 + 66 - 43= 99.

Underwriting profit:	
Net earned premium:	202
Less: Expenses:	(30)
Add: Increase in DAC	2
Less: Net Claims	(99)
Underwriting profit	75

(ii) *Many students explained the expected difference in the profit, rather than calculating the difference. Credit was given for explanations that described how premium reserves would change and how this would affect the underwriting profit. But many of these explanations did not demonstrate a clear understanding of changes in premium reserves and the impact on underwriting profit.*

Consider a policy written at time t after the start of the year. The proportion of risk outstanding at the year end would be:

$$\frac{\int_{r=1-t}^{1} krdr}{\int_{r=0}^{1} krdr} = \frac{\left[\frac{kr^2}{2}\right]_{1-t}^{1}}{\left[\frac{kr^2}{2}\right]_{0}^{1}} = (1-(1-t)^2) = 2t - t^2$$

If the business is evenly distributed over the year the outstanding proportion of risk at the year end would be:

$$\int_0^1 (2t - t^2)dt = (1 - \frac{1}{3}) = \frac{2}{3}$$

On average, however, there would still be six months' worth of premiums still to be collected. The UPR would thus be 2/3 – ½ = 1/6 of the annual premium.

Beginning of the year:
The net written premium was 228 – 42 = 186.

The UPR = 186 * 1/6 = 31.
End of the year:
The net written premium was 264 – 66 = 198

The UPR = 198 * 1/6= 33.

Thus the revised underwriting profit would be 75 – 33 + 31 = 73.

QUESTION 8

(i) *This question was mostly bookwork but required students to link reasons for distortions in the data with actions that could be taken. Credit was given to reasonable reasons and actions. But some students listed standard data checks and many students failed to suggest appropriate actions, Students who linked the reasons for distortions and possible action performed well.*

Suggested solution:

Checks on data:

- Changes in the policy document that allowed or disallowed certain claims from the date of the change. The claims could be adjusted by eliminating such claims from the data, or the data restricted to that which applied after the date of the change.
- Changes in underwriting philosophy. This may occur from a change in the underwriting staff or policy. In such a case only data from the date of change would be used.
- Errors in the underlying data. The data would have to be examined. Where atypical development is observed the original data should be checked.
- Atypical claims. There may be claims that are not expected to recur or are only expected to occur infrequently. Such claims, if large, can easily cause large distortions in the development factors. These claims should either be removed, or reduced or spread to allow for the incidence in expected claims.
- Changes in legislation. This could change the incidence of claim and the amounts that are claimed. This should be checked with the claims department of the company concerned. The impact of the changes would have to be estimated and the data adjusted accordingly.
- Alternatively only data from the date of change onwards would be used.

- Changes in claim definitions or the speed at which claims are handled. The impact of this would have to be estimated and the development factors adjusted accordingly.

(ii) *This question required some quite straight forward. Many candidates performed well.*

Suggested solution:

Method & reason:

- Bornhuetter-Ferguson method.

- This method uses the expected loss ratio for each accident year to determine the total expected losses and the development experience to determine its spread using chain ladder techniques.

- As a consequence the projections tend to be less volatile.

(iii) *This question required some application of knowledge. The majority of candidates were able to describe the process. Better candidates were able to describe how the process would be used to assess the whether the reliability of the method used for determining reserves.*

Suggested solution:

Back-test:

- Assumptions:
  - That the loss ratio will be as anticipated in the projection.
  - That the development of claims will be the average of that experienced in the past.
- The data available for the end of the previous year would be used to project the reserves at that date using the valuation method. The cells containing the projected claims for the current year would then be compared to the actual data that emerged during the past year.

- The reliability of the method to forecast the actual claims could thus be measured.
- Where there were large differences in the experience to that forecast, the data could be examined to try and establish whether there were any factors that undermined the assumptions of the B-F method and if so, how the method could be improved for the current year.