

# **EXAMINERS' REPORT**

*November 2014 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. Facultative reinsurance is a reinsurance arrangement covering a single risk as opposed to a treaty arrangement; commonly used for very large risks or portions of risk written by a single insurer.

There is no obligation for the ceding company to offer the business, nor is the reinsurer obliged to accept it. Each case is considered on its own merits and the reinsurer is free to quote whatever terms and conditions it sees fit to impose for that risk.

Advantages:

- Because the insurer is not obliged to reinsure the risk it allows the insurer to better fine-tune its reinsurance cover.
- The insurer can make use of several reinsurers to help diversify its reinsurance cover.
- The insurer can seek the best terms available at the time cover is required.
- The insurer is able to write large/unique risks which are beyond the scope of any treaties.

Disadvantages:

- It is a time-consuming (and costly) exercise to place the reinsurance when required.
- It is not certain that the required cover will be available when needed.
- The price and terms offered for the cover may not be acceptable.
- As the reinsurer will need to protect itself against anti-selection terms are not likely to be attractive.
- It is unlikely that the insurer will have access to financing commission to help offset initial expenses.
- The insurer may not be able to accept large risks automatically (until it finds appropriate reinsurance), which may reduce sales and its standing in the market.

ii. QS Recovery from A =  $25\% \times R3.8m = R0.95m$

iii. EML to A:  $0.25 \times R3m = R0.75m$   
EML left after A:  $R3m - R0.75m = R2.25m$   
EML retained:  $R0.75m$   
EML accepted by B:  $R1.5m$  (i.e.  $2/3$  of the balance after A)  
Balance of claim after A:  $R3.8m - R0.95m = R2.85m$   
Recovery from B:  $2/3 \times R2.85m = R1.9m$

iv. Net claim after A&B:  $R3.8m - R0.95m - R1.9m = R0.95m$

Let the unknown index value be I.

Then (with amounts in R'm):

$$80\% (0.95 - 0.375I) = 0.4$$

$$0.95 - 0.375I = 0.4/0.8 = 0.5$$

$$I = (0.95 - 0.5)/0.375$$

$$= 1.2$$

v. Advantages of a “stability clause”:

- In an inflationary environment it will help to maintain the same real value of cover provided.
- It will help keep premiums down, since without this the reinsurer would have had to make an allowance for the erosion of the excess point by inflation.

*Part (i) was not handled as well as would have been expected for a straight bookwork question. Several candidates ignored the instruction to “outline briefly” the advantages and disadvantages, and were not awarded marks for statements such as “flexibility”.*

*The calculation parts, (ii)-(iv), were fairly straightforward, and were answered reasonably well by most candidates. Some candidates, however, needlessly lost marks by not showing workings, or by not indicating currency / units in answers.*

*Many answers to part (v) were poor, highlighting a lack of understanding on the candidates’ part.*

## QUESTION 2

i. The following considerations would need to be taken into account when setting up a GLM:

- Sources of data and cleaning
  - Before any modelling can begin, one needs data. Therefore, one needs to consider where these data can be obtained e.g. is it internal data or external (e.g. from industry or purchased through an alternative source). In addition, once the data have been obtained, it should be checked for any obvious errors and various data checks should be carried out.
- Consider the form of GLM used before (if appropriate) or what would be an appropriate distribution and link function to use e.g. gamma distribution with a log link
- Which factors to include in the model
  - Only include factors that add value and make sense.
  - Want to apply the principle of parsimony so that as few as possible parameters are included in order to provide a satisfactory fit.
- Analysis of significance of factors
  - In determining which factors are statistically significant one would need to analyse various statistics (e.g. AIC, BIC, chi-squared statistics and deviance) in order to determine whether to include parameters in the models.
- Approaches to classification
  - Another consideration to take into account is the use of grouping of levels of factors referred to as classification. Using different groupings within factors can produce better results than with other groupings e.g. rather than using post code for geographical locations we could use province or urban vs rural areas. Techniques that could be used include CHAID (Chi-squared Automatic Interaction Detector) and decision trees.

- Measuring uncertainty in the estimators of the model parameters
    - One should always calculate confidence intervals for parameters and hence determine whether a parameter is significantly different from zero.
  - Comparison with time
    - One should check the consistency of parameter estimates over time and also whether a time trend is incorporated within the model.
  - Consistency checks with other factors
    - Consistency checks should be run on all factors e.g. when setting up a model for a multi-distribution channel business, one should check each factor to ensure that it is value for every channel.
  - Restrictions on the use of factors in the model
    - Legal and commercial consideration should be checked e.g. whether gender can be used as a factor in the model. When certain restrictions are imposed, adjustments to the model can be made to compensate to an extent for this by adjusting the fitted relativities for correlated factors (which is achieved using the offset term in the GLM).
  - Correlation between predictor variables
    - One should understand the correlations within a portfolio which will help to understand the results.
  - Parameter smoothing
    - One needs to consider the trade-off between goodness-of-fit and smoothness.
    - When modelling one needs to consider how much smoothing one should apply to the parameters between different levels of a risk factor and still make sure that the overall risk premium is sufficient for the group.
    - Smoothing may be particularly necessary where data are sparse and erratic movement between levels of a certain rating factor may be due to randomness.
    - Trade-off between time and resources (a more complex GLM which is more accurate and thoroughly tested versus a more simple model which can be run quickly and produce results quickly).
- ii. In order to price the excess of loss reinsurance contract for this book of motor insurance policies using the GLM for accident claim severity, one could use the frequency-severity approach which involves analysing and projecting frequency and severity separately and then combining the two to calculate the risk premium.

The GLM to predict the accident claims can be used to model the severity of the claims. Then a decision would need to be made about how the frequency within the model would be modelled. This could involve the use of a Poisson model or Negative Binomial model.

We can then combine the frequency and severity distributions to produce a stochastic model for the cedant's losses on the book of motor insurance policies.

The following steps would then need to be carried out:

1. A simulation would then be carried out to simulate the losses for each policy over a period of n years (essentially carrying out a Monte-Carlo simulation).
2. Then for each of these losses we apply the policy deductibles and limits
  - each ground up loss (gross of deductible) is trended to the future average date of loss
  - the deductible is netted out and the loss is capped at the policy limit

- the resulting loss is then applied to the reinsurance layer
3. Losses in the layer are then aggregated by year (treaty year or accident year, depending on the basis of the analysis).
  4. Historical subject premium (earned or written) is adjusted for rate changes and for exposure changes to the prospective premium level.
  5. The loss cost to the layer by year is calculated by dividing the ultimate trended losses in the layer by the corresponding adjusted premium.
  6. An average of the loss cost is taken between appropriate years of experience e.g. using credibility theory.
  7. Other loadings for catastrophes and uncertainty within the model can be added on.
  8. The reinsurance rate is developed by loading the loss cost for reinsurer's expenses and profit.

*Part (i) was generally well answered. The most common mistake made was allocating too much time to discussing data adjustments and data issues. The question asked for modelling considerations when setting up the GLM but candidates missed out on a number of easy marks by not covering general modelling considerations. Many candidates were not specific enough or did not give sufficient detail when outlining points, e.g. specifying that one needed to group rating factors into homogenous groups but not mentioning the techniques that could be used such as CHAID.*

*Part (ii) was very poorly answered by most candidates. In order to calculate the risk-premium it is necessary to calculate the expected cost, which incorporates both frequency and severity. Most candidates did not make the link that a frequency model would also be required (in addition to the GLM model for accident severity) before the risk premium can be calculated. Furthermore, most candidates focused on the average claim size multiplied by the average frequency number. This would not be appropriate for excess of loss reinsurance (especially with high retention limits) and one would need to look at a simulation model to get a more accurate estimate of the cost. Candidates who made these links generally did well.*

### **QUESTION 3**

i. Data issues:

- Longer reporting delays as reinsurers need to incorporate the insurers' delay in receiving information.
- Greater tendency for claims to develop upwards for non-proportional business. Longer reporting delays for larger claims gives more time for economic and social factors to increase the claim.
- Greater level of heterogeneity as reinsurers accept business from many insurers each possibly selling a diverse range of insurance products.
- Sparse data particularly for high excess reinsurance, as the reinsurer is only notified of claims close to the excess points which are rare.
- Reduced applicability of industry benchmarks arising due to heterogeneity of exposures.
- Data and systems, reporting of aggregate information especially for proportional business means less detail is available to the reinsurer.

- Data grouping for reserving can be challenging given heterogeneity of experience.
- Case estimates may not be consistently calculated i.e. the methodology is likely to be different for different insurers and so incurred claims data can produce distorted results.
- Data may be out of date and so not as relevant due to longer reporting delays.
- Errors in data may not be easily picked up given that the reinsurer does not have access to the same level of detail as the insurer.
- Data quality may vary and depends on the quality of the data received by all insurers.
- Layout and format of data are likely to differ between reinsurers which may complicate the analyses.
- Data may not be recorded consistently between insurers, and with the same insurer over time.
- Data may not be complete for non-proportional claims as the reinsurer only receives information in excess of the deductible

ii.

Accident Year	IBNR/Earned Premium	Incurred Loss Ratio	Ultimate Reserving Loss Ratio	IBNR/Case Estimates
2010	0.0%	59.6%	59.6%	0.0%
2011	1.3%	78.5%	79.8%	130.7%
2012	2.0%	44.3%	46.3%	46.6%
2013	11.2%	48.8%	60.0%	129.1%
<b>Totals</b>	<b>4.6%</b>	<b>56.2%</b>	<b>60.8%</b>	<b>106.0%</b>

IBNR/Earned Premium:

- This ratio increases when moving from older to more recent accident years.
- This is as expected as the level of IBNR is higher relative to the earned premium for the most recent accident year where there is the greatest level of IBNR.

Incurred loss ratio:

- This ratio is lower in more recent accident years (i.e. 2012 and 2013) and higher in older accident years (i.e. 2010 and 2011). There could be many factors causing this and further investigation is needed.
- The loss ratio in the 2011 accident year is relatively high compared to other accident years and should be investigated further.
- The incurred loss ratio is lower or equal to the ultimate loss ratio and so some positive development is still expected. This is especially true for the 2013 accident year where most of the IBNR sits.

Ultimate loss ratio (ULR):

- The ultimate loss ratio is close to the incurred loss ratio in the 2010 and 2011 accident years implying that not much further development is expected here.
- In the 2013 accident year the ultimate loss ratio is somewhat higher than the incurred loss ratio which is as expected as this year is the most underdeveloped.
- In the 2013 accident year the ultimate loss ratio is somewhat higher than the incurred loss ratio which is as expected as this year is the most underdeveloped.
- ULR is consistently below pricing loss ratio. This could mean that the pricing was very prudent or that ULR are too low. Further investigation is needed to reconcile these differences.
- The ultimate loss ratio is high in the 2011 accident year. This could be due to a large claim or aggregation of claims and further investigation is required.

IBNR/Case Estimates:

- The ratio is 130.7% in the 2011 accident year and then decreases to 46.6% in the 2012 accident year before increasing to 129.1% in the 2013 accident year.
- A high ratio is expected as this is reinsurance business with more delays than direct insurance.
- The highest ratio is expected to be in the 2013 accident year where most of the IBNR sits.
- The high ratio in the 2011 accident year is surprising and should be investigated further, though given the lower level of case estimates this is not likely to be material overall.

Other possible diagnostics are calculated below.

<b>Possible Diagnostics</b>				
Accident Year	IBNR/Paid claims	IBNR/Reported claims	IBNR/ULT	Paid/Earned Premium
2010	0.0%	0.0%	0.0%	59.0%
2011	1.7%	1.7%	1.7%	77.4%
2012	4.9%	4.5%	4.3%	40.1%
2013	27.8%	22.9%	18.6%	40.2%
<b>TOTAL</b>	<b>8.8%</b>	<b>8.1%</b>	<b>7.5%</b>	<b>51.8%</b>

<b>Possible Diagnostics</b>				
Accident Year	Reserves/paid	Paid/Case	ULR/Pricing LR	Paid/Incurred
2010	1.2%	86.43	72%	98.9%
2011	3.1%	75.61	94%	98.7%
2012	15.6%	9.43	59%	90.4%
2013	49.4%	4.64	86%	82.3%
<b>TOTAL</b>	<b>17.5%</b>	<b>11.61</b>		

iii. Additional analyses:

Analysis of emerging experience:

Investigate how expected experience as at the last valuation compares to actual experience.

- Breakdown total movement into:
  - Difference between actual and expected movement in paid claims.
  - Change in paid development pattern.
  - Change in prior loss ratio.

Use different methodologies to calculate the IBNR:

Only the chain ladder using paid claims data is used to project to ultimate. Other methodologies which could be used include:

- Chain ladder using incurred data
- Average cost per claim method
- Bornhuetter-Ferguson

The results of other methodologies should be compared to the chain ladder on paid claims data.

Data:

- Ensure that the data used in the valuation reconciles to other sources e.g. management accounts
- Understand movements in the data from the previous valuation
- May need to identify and separately analyse large or catastrophic claims

Investigate Development Pattern Diagnostics:

- Compare assumed future development patterns with past development patterns
- Check for distortions across calendar year, development and origin years
- Check for very high or low development factors and investigate sensitivity of results to the inclusion or exclusion of these factors

Compare results to benchmarks:

- Compare paid development pattern to:
  - Industry benchmarks or your own past experience.
  - Development pattern of an insurer selling this class of insurance. Expect to see a slower development pattern as this is reinsurance which has longer delays.
  - Other classes of business for the same company.
  - Other clients as you are from a consultancy.
  - IBNR for regulatory accounts if different.
- Can compare specific diagnostics e.g. IBNR/Premium to industry benchmarks, other classes or previous accident years.

Other areas:

- Understand where you are in the underwriting and reserving cycle.

- Discuss any peculiarities with the client, e.g. changing of case estimation philosophy.
- Consider retrocessions, reinstatements and any potential profit or sliding scale commissions which may need to be allowed for.
- Investigate why the loss ratio used in the latest accident year has changed from 70% to 60%.
- Understand differences in the pricing loss ratio and the ultimate loss ratios used for reserving in the latest accident year i.e. why the pricing loss ratio is 70% while only 60% is used in reserving.
- Court precedents & recent court rulings which could affect the number and size of claims.
- Attitudes of policyholders and their propensity to claim. This could affect the number and size of claims and hence IBNR reserve.
- Analyse changes in reinsurance and policy terms and conditions which could affect the size of the IBNR reserve.
- Adjust for economic cycle e.g. recession could lead to an increased propensity to claim for claims that have been incurred, and lead to a higher IBNR reserve.
- Understand any changes on case estimation strength which would impact the IBNR (assuming this includes IBNER and incurred data is used).
- Sensitivity testing to key assumptions e.g. loss ratio, maybe use pricing loss ratio, assumed could be varied or different inflation assumptions could be used in basic chain ladder.
- Check validity of chain ladder assumptions.
- Check that there are no reserves missing i.e. prior to 2010.
- Qualitative assessments, discussions with claims and underwriting.
- Understand and quantify uncertainty in IBNR reserve estimates.
- Allowance for any expense reserves.
- Analyse change in mix of claim types, business mix (i.e. change in insurer mix) within particular insurance class.
- Adjustment for latent claims that have not be included in the IBNR reserve.
- Allowing for trends that may perhaps not be fully allowed for in the reserving methodology.

*Part (i) was book work and was generally well answered by most candidates.*

*Part (ii) was not well answered. The idea was to calculate diagnostics, explain the calculation and how this serves to validate the IBNR. It was not always clear that candidates understood that the pricing loss ratios were not directly used in calculating the IBNR, and that the methodology described in the additional information was in fact used. For example some candidates commented on the change in the pricing loss ratios. Marks, however, were given for comments on the change in the pricing loss ratio given that there is a link between the pricing loss ratios and the ultimate loss ratio used in reserving. The majority of candidates did not calculate IBNR as a percentage of premiums.*

*Part (iii) was not very well answered. Candidates who scored well were those who could generate a list of wide ranging points. The question was specific to IBNR it was not always clear that candidates understood this, with some commenting on outstanding reported claims.*

*Few candidates commented that data used should be reconciled to an independent source, e.g. management accounts, which is the first step in any valuation. A number of candidates commented that the mix of business should be monitored, however the IBNR was calculated for one specific class of business.*

## **QUESTION 4**

i. This insurance indemnifies the insured employer against legal liability to compensate an employee or his estate for bodily injury, disease or death suffered owing to negligence of the employer in the course of employment.

Legal costs for the employer may also be covered.

Liability for loss of or damage to employees property is usually also covered.

ii. The characteristics of the claims are as follows:

Liabilities relating to injury or disease will be long-tailed, due to:

- reporting delays: potential claims could remain undetected for many years; the long-tail is exacerbated if the cover was written on a losses-occurring basis (as is common);
- settlement delays: these could also extend over a number of years caused by the need to establish the extent of liability. Litigation for large claims will usually further extend the tail of claims by several months or years;
- if the benefit is in the form of regular payments to compensate for disabilities, this will further lengthen the tail for these types of claims.

The legal environment will have a significant effect on settlement delays.

Claims that relate to property damage will be much shorter-tailed due to shorter reporting delays and settlement delays.

Claims relating to property damage are relatively small compared to those for bodily injury and disease and death.

All claims will be inflation-linked:

- claims related to medical costs incurred due to injury or disease will be linked to medical inflation;
- claims related to compensation for loss of income will be linked to wage inflation;
- claims may be subject to court award inflation, which may be higher than medical or wage inflation in some legal jurisdictions where there is bias in favour of claimants;
- legal costs and other claim handling costs will also be inflation linked;
- even claims relating to property damage will be inflation linked (e.g. the cost of repairing or replacing a car damaged in a fire at the workplace).

If the employer has operations in a number of countries, claims will probably need to be settled in the country where the liability arose, hence claims could be denominated in a variety of currencies.

Suitable assets could include:

- Index-linked bonds: to the extent that these are available for appropriate maturity terms; these bonds (if held to maturity) will provide returns linked to an inflation index. However these bonds are usually linked to consumer prices, hence will unlikely match medical and wage inflation that are usually higher than consumer inflation. Emerging markets usually do not have well developed index-linked bond markets, so such bonds may not be available, or available at an acceptable price. Dealing costs are therefore likely to be relatively high.
- Equities: these should be expected to provide a return over long terms that exceeds the increase in consumer prices, hence could be a good match for long-tailed liability claims. However these assets could provide poor or negative returns over short or medium terms, so they would not be suitable for matching anything other than long-term liabilities. Emerging market equities are likely to be more volatile than developed world equities, which could reduce their suitability to match liabilities.
- Fixed interest bonds: these should be available at various terms, and returns do allow for inflation expectations at the time of purchase, however as returns are fixed in monetary terms they do not provide for protection against unexpected inflation. Hence they are not suitable for long-tailed inflation-linked claims, but could be suitable for short and even medium-term inflation linked claims, as even if inflation differs from expected, the timescale is such that it should not lead to a material loss of real value. Corporate fixed interest bonds may provide additional returns at higher risk, which may not be suitable for a small insurer, however sometimes higher returns are compensation for low liquidity (not higher credit risk), making these assets suitable for long-tailed liabilities.
- Cash: Returns depend on monetary policy, however cash returns should be loosely linked to consumer price inflation, however there will likely be periods of negative real returns. Cash is highly liquid, however this may not be a significant factor for an insurer with mostly long-tailed liabilities.
- Property: While property is expected to provide real returns in the long term, direct property would not be suitable for a small insurer. Indirect property might be suitable, provided it is reasonably liquid (i.e. no long term notice periods required for unit redemptions) and sufficiently diversified and invested in good quality commercial properties. Dealing and management costs are likely to be relatively high.

iii. Factors include:

- as the company is small, it may choose assets that have more stable values to reduce solvency risk;
- a greater level of free reserves will enable greater mismatching, however a small insurer will unlikely be able to mis-match to a great extent;
- need for diversification to reduce investment market risk (which can be large in an emerging market) may lead to some mismatching;
- availability of suitable assets in the emerging market may force some mismatching;
- extent to which the insurer can rely on premium income to meet short-term expenses and claims may allow it to mismatch;
- extent to which liabilities have been reinsured may increase investment freedom;
- company's attitude to risk and access to parent company resources may influence investment freedom;
- outlook for returns for various asset classes may lead to short term tactical decisions leading to mismatching;
- regulatory requirements, including admissibility rules, may force the insurer to mismatch.

*This question was reasonably well answered on the whole.*

*Part (i) was a bookwork definition, however, few candidates got it completely right.*

*Part (ii) was clearly an investments question. The liability characteristics that candidates should have focussed on were those that have relevance to the investments. Some candidates wasted time by describing irrelevant characteristics, such as rating factors and exposure measures likely to be used. Simply stating that cover can be on a claims-incurred or claims reported basis without explaining the relevance for the assets is not answering the question asked.*

*Part (iii) was well answered by most. Some candidates thought that mismatching is the same as tactical asset allocation, so thought that dealing expenses is a relevant factor, without realising that a planned mismatch strategy can be a long-term investment strategy of the insurer.*

## **QUESTION 5**

i. Improvements in technology include:

- Improvements in safety features e.g. ABS braking: Reduce the number of accidents and hence claims cost.
- Increased engine performance: Could increase accidents if it results in drivers driving faster, therefore increasing claims costs. However, this is balanced by improved safety features. Could also allow drivers to accelerate out of dangerous situations which could lead to reductions in claims.

- GPS tracking: Increases theft recovery reducing theft claims.
- Improved security (alarm systems, keys, etc.): Reduces theft claims.
- Rear-view cameras/sensors: Reduces small accidents (hitting poles, etc.), reducing claims.
- Seat-belt reminder beep: May potentially reduce passenger liability claims for bodily injury.
- Airbags: May potentially reduce passenger liability claims for bodily injury.
- Telematics devices: Allow monitoring of driver behaviour, which has the potential to encourage better driving (in an attempt to earn reduced premiums) and hence lower accident frequencies and possibly severities.
- More electronic components e.g. adjustable side-mirror: May increase costs of repairs.

ii. Reasons why it is important to adjust premium rates to keep up with new technology include:

- Premiums need to cover all costs incurred by the insurer, including claims costs.
- Changes in technology have the potential to increase or decrease these costs and hence the premium needs to change accordingly.
- If premiums are not increased when claims costs increase then insurers will make lower profits than required, or perhaps even losses.
- If premiums are not decreased when claims costs reduce, the insurer may be over-priced compared to competitors and hence lose business to competitors.
  - The business that will be lost will be the better risks as premiums are too high relative to the risk they present to the insurer.
  - The business lost could also be the larger policies (assuming improvements in technology are more prevalent with expensive cars), which may result in a problem of recovering fixed expenses if larger policies contributed more to fixed expenses (cross-subsidising smaller premium policies).
  - Irrespective of size of policies lost, lower business volumes will reduce the insurer's ability to recover fixed costs.

iii. Factors:

- Frequency of significant improvements in technology. The more frequent the improvement, the more frequently updates are required to remain up to date.
- Customer loyalty. May be affected by distribution channel. For example, broker policyholders may be slower to change insurers even if their premiums are not reduced soon after they buy a new car with new technology.
- Cost of premium update, including staff costs e.g. actuary. Cost-benefit analysis. The benefit of the update needs to be compared to other competing uses of the actuary's time.
- Percentage of policyholders with new vehicles who are likely to have the latest technology on their vehicles. If only a small percentage, this will reduce the benefit of the update.

- Level of competition in the market and how quick competitors are to adjust their rates. If competitors adjust their rates slowly, then less frequent updates are required.
- Strategy of insurer. Even if competitors are not adjusting rates quickly, it may be the insurers strategy to be a market leader to attract customers with the latest technology in their vehicles.
  - May allow greater recovery of fixed expenses due to larger premium policies.
  - May also wish to attract customers with better technology because of the lower risk. The insurer may be able to reduce premiums less than the expected reduction in claims costs.

*Part (i) was relatively straight-forward and most candidates achieved close to full marks. The question did not specifically state that the technology needed to be related to motor vehicles themselves, so many ideas earned credit.*

*Part (ii) was well answered by most candidates. Some candidates focussed too much on a specific argument while leaving out important points (such as recovering fixed costs or anti-selection).*

*A few candidates scored poorly on part (iii) due to misinterpreting the question resulting from not reading the question carefully. Some candidates gave reasons for incorporating technology into product design and not explaining why updating premiums might be more or less important, which is what was asked. A number of candidates suggested when it would be possible to update premiums regularly, which was not answering the question.*

## **QUESTION 6**

i. Difference between regulatory and economic capital:

- Regulatory capital is the amount of capital an insurer is required to hold for regulatory purposes.
- Economic capital is the amount of capital that a provider determines is appropriate to hold given its assets, liabilities, and business objectives.  
i.e. given the specific risks that the insurer is exposed to.
- If regulatory capital is based on a risk-based formula, then it is possible that regulatory capital will equal economic capital.
  - However, there may be certain differences, e.g. where certain assets are inadmissible under the regulatory capital calculation.
- However, regulatory capital may also be calculated according to a simplified formula.
  - e.g. percentage of net written premium.
  - More complicated standard formula calculations under SAM and Solvency II.
- In this case it is possible that regulatory capital differs significantly from the company's economic capital.

Factors influencing the type of capital held:

- The company will always need to hold capital at least equal to regulatory capital. (i.e. if the company's economic capital is less than this amount then the company will be required to hold regulatory capital.)  
This might be the case:
  - If the regulatory capital calculation is particularly harsh; or
  - because the regulatory capital formula is based on the "average company" and this particular company has different characteristics, resulting in the capital requirement being too high for this particular company.
    - e.g. the company has a number of classes, resulting in a diversification benefit which is not picked up when capital is calculated as a % of net written premium.
- If economic capital is greater than regulatory capital then the company will need to make a decision as to what level of capital to hold.
- Factors that may influence this decision include:
  - Risk appetite of board of directors: Lower risk appetite means the company will hold more capital to reduce the risk of insolvency.
  - Return on capital: The more capital held the lower the return on equity (ROE) will be. Directors will need to decide on what a suitable ROE is and make sure that capital is low enough to meet this return.
  - Reputation: Company may believe that holding extra capital will increase confidence in company and encourage potential policyholders to buy insurance.
- It is possible that the company will choose to hold more capital than both regulatory and economic capital.

ii. a. The effect:

- Modelling cash flows stochastically will allow for the fact that cash flows can be higher or lower than expected.
- The capital requirement will probably be increased by modelling these cash flows stochastically because capital is for years in which there is poor experience.
- Unless the deterministic variables have been based on unrealistically adverse experience, in which case capital requirements may reduce.

b. Advantages:

- Attempting to parameterise the Normal distribution will force the insurer to think about the variability of each of the quantities, which will increase understanding of risk.
- The Normal distribution is common and well understood. (As long as users of the model are aware of the limitations e.g. not very skewed.)
- If the company's capital requirement increases, this would be more prudent and preferred by the regulator.

c. Disadvantages:

- The capital requirement may increase beyond the client's available capital.
  - This is possible because the company's capital is currently only at the 1 in 250 level).
- It will take extra time and resources to parameterise all of the distributions.
- If the variables do not present that much randomness, the additional cost may not be worth the effort.
  - However, the regulator will want all risk to be taken into account.
- The Normal distribution is not fat-tailed, so the true level of risk may be underestimated, depending on the quantity being estimated.
  - This could create a false sense of confidence in the capital figure (spurious).
  - However, the possible outcome will be for the company to hold more capital which is more prudent and preferred by the regulator, regardless of whether the company has a false sense of confidence in the capital figure or not.  
*(This point is a repeat of the advantage given above, but shows additional understanding in this context i.e. there is a disadvantage of the Normal distribution, but overall there is still an advantage.)*
- Some cash flows are strictly non-negative in reality and the Normal distribution allows for negative values.
  - However, the probability of negative cash flows may be small depending on the distribution parameters.

*In part (i) most candidates gave suitable definitions for both economic and regulatory capital, although a number failed to explain the differences between the two types of capital. The sub-part asking for factors that affect which of regulatory or economic capital is likely to determine the amount of capital held was not well answered. Most candidates simply stated the reasons why a company would hold more capital.*

*In part (ii) a number of candidates gave generic answers relating to the advantages and disadvantages of modelling variables stochastically rather than deterministically. Most candidates failed to mention the key point that modelling previously deterministically modelled variables stochastically will increase the capital requirement. Several advantages and disadvantages were related to this point.*

## QUESTION 7

i. Risks:

- Liquidity risk:  
AviSure will need to make large payments as a result of the claims emerging from the two events. There will be significant pressure on liquid assets, and may result in illiquid assets needing to be sold on unfavourable terms to meet the cost of claims.

- Reserve risk:  
There is likely to be greater uncertainty about the amount of liability claims emerging from the two events due to the longer tail of these claims and the influence of court decisions. There will therefore be greater risk that reserves set up to cover claims for these events turn out to be insufficient to meet the eventual cost.
- Aggregation of risk:  
There is a risk that there are more events leading to large claims in the near future. This would put further pressure on AviSure's capital and possibly threaten the solvency of the company.
- Increased uncertainty about future large claims:  
Avisure may not have realised the potential for such large losses to happen so close together, which may result in the company becoming more concerned about future large losses.

Mitigations:

- Liquidity Risk:
  - Initiate process to sell some illiquid assets in anticipation of high claims.
  - Arrange for financial reinsurance to receive some capital support.
- Reserve Risk:
  - Request reserving assistance and data from reinsurers.
  - Include a margin for uncertainty in reserves.
- Aggregation of Risk:
  - Increase Aggregate XL cover.
  - Increase proportional reinsurance cover.
- Increased uncertainty about future large claims:
  - Further risk excess of loss reinsurance cover.
  - Include specific cover where multiple planes/ships are damaged from collisions

*Credit was also given for other risks, including: reinsurer default; downgrading of credit rating; regulatory intervention if solvency margin falls below required minimum.*

ii. Adjustment of parameters:

- The loss distributions will allow for an element of random variation, specifically the possibility of claims being higher than average.
- If the “triplet” of large claims can be seen as an extreme value from the current loss distribution then:
  - the parameters of the capital model would not be changed,
  - because the distribution is still considered correct/plausible, it was just an extreme observation from the distribution.
- However, if the “triplet” was not accounted for in the loss ratio distribution parameter estimation process then AviSure might:
  - increase the mean of claims, and/or
  - increase the variance,

to allow for the possibility of such large losses in future.

*In part (i) candidates generally recognised that claims were going to be higher than expected, but not many could articulate the claims risks sources, i.e. reserve risk and accumulations of future losses nor the liquidity risk associated with the combination of large losses.*

*Part (ii) was better answered in general, with more candidates understanding that the model will only have to be changed if the frequency and/or severity distributions did not make allowances for such losses previously.*

## **END OF EXAMINERS' REPORT**