

INSTITUTE AND FACULTY OF ACTUARIES

EXAMINERS' REPORT

September 2019

Subject SP7 – General Insurance Reserving and Capital Modelling Specialist Principles

Introduction

The Examiners' Report is written by the Principal Examiner with the aim of helping candidates, both those who are sitting the examination for the first time and using past papers as a revision aid and also those who have previously failed the subject.

The Examiners are charged by Council with examining the published syllabus. The Examiners have access to the Core Reading, which is designed to interpret the syllabus, and will generally base questions around it but are not required to examine the content of Core Reading specifically or exclusively.

For numerical questions the Examiners' preferred approach to the solution is reproduced in this report; other valid approaches are given appropriate credit. For essay-style questions, particularly the open-ended questions in the later subjects, the report may contain more points than the Examiners will expect from a solution that scores full marks.

The report is written based on the legislative and regulatory context pertaining to the date that the examination was set. Candidates should take into account the possibility that circumstances may have changed if using these reports for revision.

Mike Hammer
Chair of the Board of Examiners
December 2019

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

1. The aim of this General Insurance Reserving and Capital Modelling Specialist Principles subject is to instil in successful candidates the ability to apply, in simple reserving and capital modelling situations, the mathematical and economic techniques and the principles of actuarial planning and control needed for the operation on sound financial lines of general insurers.
2. Candidates who are well prepared generally appear to perform reasonably on SP7, although a number of candidates do not appear to be adequately prepared, or show poor exam technique. The following points are always worth considering to improve performance:
 - (i) Lists are hugely valuable for breadth of point generation but candidates should always exercise judgement when applying them. In many instances questions will be specifically designed to render a number of the standard point inappropriate and marks (often generous multiple marks) will be available for identifying and articulating these nuances well.
 - (ii) Calculation questions will come up on a regular basis within SP7 papers. Candidates should always be prepared for such staples as balance sheet preparation, triangle manipulations & projections and reinsurance layer calculations (along with being able to carry out any necessary adjustments including inflation, exposure, earning distortion and time period issues). Further, if the examiners cannot follow candidate's logic they cannot give partial credit for incorrect calculations. Therefore a clear audit trail should be left to help secure appropriate method marks where the calculations are incorrect.
 - (iii) Capital questions should be expected on every paper and represent a sufficient proportion of the course content that candidates should not expect to be able to pass on their reserving knowledge alone. Those who do not encounter capital work in their professional lives should be particularly careful to ensure that they take time to familiarise themselves with this element of the course.
 - (iv) Candidates should aim to be able to give near exact glossary definitions as incoherent or vague descriptions will not score marks. If candidates struggle to remember definitions verbatim, they should take the time to properly analyse the glossary definition to ensure they have fully absorbed all the nuances of the definition.
 - (v) It is important to always read the question properly and to answer only what you are asked.

(vi) Always assume that question content is there for a reason. If something is pure bookwork, it should be obvious as such as it will generally go straight to a question with little or no specific context. These are the only sorts of questions where you should expect to provide generic answers. Otherwise you will need to make reference to the situation posed in the question to score well. For example if lines of business, types of insurance entity, a specific set of regulatory requirement or anything else is mentioned they have been chosen as they have an impact on the answer. If numbers are mentioned, they are there because we expect you to look at them, think about them and offer some comment or display some ability to notice unusual features of a table of numbers (a key skill for an actuary). Every exam there will be a significant number of candidates who are clearly extremely well prepared, who write very long answers that clearly display all the based knowledge one might require to be able to think intelligently about a question, but they score poorly because the answer is purely generic with no obvious attempt to actually address the question scenarios.

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

B. Comments on *student performance in this diet of the examination.*

Students generally performed well across all questions in this exam.

Marks dropped often related candidates not carefully reading the question. Examples of these include:

- Putting down generic points when a question specifically asked for an answer in relation to a class or portfolio, such as Question 4(ii)
- Ignoring key words, such as Question 6(iv) where the question asks for how risk is mitigated and people gave examples of different types of documentation

As is often the case the calculation question, Questions 7(iii), was answered well by better prepared candidates. Calculation questions come up regularly in SP7 and candidates should practise these as part of their exam preparation.

Question 3 was the worst answered of the paper despite being pure bookwork. Candidates should remember that it is important to study and understand regulations and regulatory framework as this is a core part of the subject aims.

C. Pass Mark

The Pass Mark for this exam was 61.

Solutions for Subject SP7 – September 2019

1(i) Examples of events:

- Data breach (electronic or physical). [½]
 - Hacker targets Telco's system(s) and prevents Telco from earning revenue. [½]
 - Phishing leading to a hacker causing damage to Telco's websites, programs, electronic data, loss of intellectual property or results in a hardware meltdown. [½]
 - A hacker tries to hold Telco to ransom. [½]
- Marks available for other sensible suggestions [½ per point with explanation]* [1]
- [3, Max 2]

Examples of insurance cover:

- Coverage of forensic investigations, legal advice and expenses, notifying customers or regulators, and offering support such as credit monitoring to affected customers for their protection. [½]
 - Crisis containment support to mitigate reputational damage such as the services of a public relations firm
 - e.g. developing communication strategies, running a crisis press office etc. [½]
 - Business interruption cover may provide compensation for loss of income (potentially including reputational damage). [½]
 - Reimburse Telco for the costs of repair, restoration or replacement of any damaged systems, hardware, etc. [½]
 - Cover the ransom paid and include the services of a risk consultancy firm to manage the situation. [½]
 - *Marks available for other sensible suggestions [½ per point with explanation]* [1]
- Note: Marks should not be given for fines as coverage as these are typically excluded under policies* [3½, Max 2]

(ii)

- Under the GDPR, breach notification is mandatory where a data breach is likely to "result in a risk for the rights and freedoms of individuals" within 72 hours of first having become aware of the breach. [1]
 - Telco may be more concerned about the potential for regulatory fines. [½]
 - Telco may be more exposed to reputational risks as customers will be more aware of incidents and their rights. [½]
- Marks available for other sensible suggestions [1 per point with explanation]* [1]
- [3, Max 1]
- [Total 5]**

This question was generally well answered with candidates being able to generate a good range of different example of event types in addition to those listed in the mark scheme alongside the coverage that would be provided.

2(i)

A policy that covers all claims reported to an insurer within the policy period irrespective of when the incident occurred. The type of cover provided by such a policy is known as claims made cover. [1]

(ii)(a)

- If the reinsurance is on a Risk Attaching basis, then the reinsurer provides coverage to all claims arising on all policies underwritten by the insurer during the coverage period. [1]
- In this situation, since the policy was issued on 21 December 2015, it will be Reinsurer A [1]

(b)

- Losses Occurring basis of Reinsurance will provide cover for losses with the date of loss occurring during the coverage period [1]
 - As the date of loss is 5th June 2017, none of the reinsurers will be liable to pay for the loss. [1]
 - ...A/B on a LOD basis but date of loss is after the end of the coverage period [½]
 - ...C/D on a RAD basis but policy issue date is before start of the coverage period [½]
- [5, Max 4]
[Total 5]

This question was well answered by most candidates.

3(i)

- Established in 1994, the IAIS represents insurance regulators and supervisors of more than 200 jurisdictions in nearly 140 countries, containing 97% of the world's insurance premium income. [1]
- The IAIS also has more than 120 observers comprising industry associations, professional associations, insurers and reinsurers, consultants and international financial institutions. [1]
- The IAIS issues global principles, standards and guidance papers, [½]
- ... provides training and support on issues related to insurance supervision, [½]
- ... and organises meetings and seminars for insurance supervisors. [½]
- It holds an annual conference where supervisors, industry representatives and other professionals discuss developments in the insurance sector and topics affecting insurance regulation. [½]
- An executive committee, whose members represent different geographical regions, heads the IAIS. [½]
- It is supported by three main committees: the technical committee, the implementation committee and the budget committee. [½]
- These committees form subcommittees and working parties (working groups, task forces and groups) to accomplish their objectives. [½]
- The IAIS has works with a number of supranational financial bodies to produce recommendations for insurers and regulators alike. [½]

- Note that marks should not be given for stating the IAIS creates regulations or that it's members are insurers (as insurers are observers). [½]
Marks available for other sensible suggestions [1 per point with explanation] [1]
[7½, Max 4]

(ii)

The objectives of IAIS are to

- Promote effective and globally consistent supervision of the insurance industry... [½]
- ...in order to develop and maintain efficient, fair, safe and stable insurance markets for the benefit and protection of policyholders. [1]
- Contribute to global financial stability. [½]

[2, Max 1]

[Total 5]

This question was generally poorly answered by candidates despite being bookwork.

4(i)(a)

Credit Insurance

- Credit insurance covers a creditor against the risk that debtors will not pay their obligations [1]
 There are two main types:
- Trade Credit... [½]
 - may cover uncollectible debts on a day to day basis, or might be sold for a duration of a project when there is a risk of non-payment at the end of the project completion. [½]
- Mortgage Indemnity... [½]
 - ...covers the lender in a mortgage loan against the risk of borrower defaulting and the value of the property on which the loan is secured not being sufficient to repay the loan. [½]

These policies may last for the duration of the mortgage and have terms of many years.

[½]

[3½, Max 2]

(i)(b)

Professional Indemnity Insurance

- Professional Indemnity insurance indemnifies the insured against legal liability for losses resulting from negligence in the provision of professional services [1]
 - e.g. wrong medical advice, wrong legal advice, error in actuarial estimation [½]
- ...Typically would be taken out by professionals – individuals or companies, such as architects, doctors, actuaries etc. [1]
- ...It could sometimes be a mandatory form of insurance in certain jurisdictions before being allowed to practice [½]
- ...or may be imposed as a condition by a professional body. [½]
- ...most policies will also have some cover for legal fees paid to courts/lawyers defending the insured [½]

[4, Max 2]

(ii)

Credit Insurance

- Trade Credit could be short tailed or long tailed depending upon the nature of the product [½]
 - With 5 years of Trade Credit data, the first cohort might be sufficiently developed for the annual type/ short-tailed type of trade credit policies as the transactions will usually be short turnaround [½]
 - For longer projects (such as ship building, construction projects), sometimes there can be a long time before the claims actually manifest... [½]
 - ...since the financial conditions and economic conditions can change over the course of the project [½]
 - Mortgage Insurance products would usually cover the entire duration of the mortgage which can be many years [½]
 - Also the claims can suddenly start to happen due to loss of jobs due to economic conditions [½]
 - As a result of this, 5 years is unlikely to be sufficient data [½]
 - It would therefore be advisable for the insurance company writing log-tailed Credit Insurance product to keep a suitable tail factor if using a chain ladder approach [½]
- Marks available for other sensible suggestions [½ per point]* [1]

[5, Max 4]

Professional Indemnity Insurance

- Professional indemnity insurance is usually long tailed... [½]
- ... so 5 years of data for Professional Indemnity is unlikely to be sufficient [½]
- This insurance is usually written on a claims made basis [½]
- If it is not written on a claims made basis then it will be subject to event delays [½]
- There can be material settlement delays [½]
- For example, it can take long legal process to establish liability... [½]
- ... which comes with associated legal costs [½]
- Tail factor will almost be essential [½]
- Will also depend upon the underlying profession insured... [½]
- ...as some like actuarial services might be shorter tailed in nature, compared to medical treatments, Lawyers, Architecture faults which can be much longer tailed [½]
- Will also depend upon the reinsurance program in place [½]
- If there is an index attached to the benefit then there is increased potential for late development meaning that a tail factor may be needed [½]
- Where relevant, the position of the layer (e.g. primary excess layer) will affect the potential materiality of a tail factor. [½]
- If there is a discovery period then this may reduce the need for a tail factor [½]
- Claims inflation [½]

Marks available for other sensible suggestions [½ per point] [1]

Note: Credit should only be given for comments on the products, not the process of creating a tail factor [8½, Max 4]

[13½, Max 6]

[Total 10]

Part (i) of this question was generally well answered, although a number of candidates seemed to confuse debtors and creditors when discussing Credit Insurance.

Part (ii) of this question was well answered by stronger candidates, the key here was to comment on the features of the particular classes of business. A number of candidates listed off generic points which while correct did not address the question asked and so would not have gained marks.

5(i)

- Classes of business written and nature of the liabilities [1]
- Size of free reserves [1]
- Geographical spread (currency) of liabilities [½]
- Tax treatment of different investments [½]
- Ethical considerations (ESG – Environmental, Social and Governance) [½]
- Statutory valuation requirements / accounting standards [½]
- Regulatory requirements, including solvency / capital requirements [½]
- Rating agency requirements / views [½]
- Peer behaviour / standard practice in the market [½]
- Target return on capital [½]
- Assets available for purchase in the market [½]
- Size of company [½]
- Risk appetite [½]
- Diversification between assets [½]
- Volatility of assets [½]
- Liquidity / marketability of assets [½]
- Term of assets [½]
- Security / Credit rating of assets [½]
- Expected return / management view of asset outlook [½]

Marks available for other sensible suggestions [½ per point] [1]
[1 ½, Max 4]

(ii)

- Depends on the relative amount of business written in each class of business [1]
- The liabilities for household are predominantly short-term [½]
- Motor liabilities are predominantly short-term but there may be some longer term liability for bodily injury claims [1]
- ... will be impacted by settlement arrangements, e.g. if bodily injuries are settled on a lump sum or regular payment basis [½]
- Employer's Liability liabilities will be a mixture of short term and long term. [½]
- Shorter-term liabilities can be matched by liquid, marketable assets such as government bonds and cash [½]
- Longer term liabilities can be matched by equities, property and long dated index linked government bonds [1]
- ... as a medium sized insurer, large indivisible assets such as property may not be a feasible investment [½]
- All liabilities in domestic market so likely to want to currency match [½]
- Liabilities are likely to be real in nature so may want assets to be also [½]
- Quality of credit will be important [½]

Up to two marks for suggested asset weightings (either qualitative or quantitative) that are consistent with the comments above and the assumed split of written business. E.g. If assume all classes are of equal size, expect a large proportion of assets to be cash and government bonds say 65% and a smaller proportion in longer term assets say 35%, 2 Marks. [9, Max 4]

(iii)

- Almost certainly the company will need to move towards a more matched position [1]
 - The term of the liabilities will gradually decrease [½]
 - And the backing assets need to reflect this [½]
 - Would want less volatility in assets [½]
 - Company will no longer be receiving premium income to meet cashflow. [½]
 - Without new money coming in liquidity will become more important [½]
 - e.g. would expect the proportion of cash to increase as time passes [½]
 - The greater the level of free reserves, the more relaxed the movement towards closer matching can be [½]
 - Statutory requirements may also differ for a company in run off [1]
- Mark for redoing weightings consistently with comments above* [1]

[6½, Max 4]

[Total 12]

This questions was generally well answered with (i) being particularly high scoring.

6(i)

- Process uncertainty is the risk inherent in writing business and settling claims in general insurance. [½]
- ...The modelling of the number and amount of claims will vary from the true value owing to random variation. [½]
- Change in development patterns [½]
- Inherent uncertainty in individual claims [½]
- Demand surge [½]
- Booked reserves different to best estimate: Process uncertainty in reserving risk may exist due to reserves in the model not being the same as the best estimates at that point in time. This could impact the reserve distribution and could be caused by: [1]
 - ...Using projected best estimates rather than actuals [½]
 - ...Using booked reserves rather than best estimates [½]
- Climate change [½]
- Broker mergers, aggregators, or new distributions channels may result in uncertainty in expected commission in underwriting risk [1]
- Increased use of profit share arrangements: Changes in profit sharing arrangements will impact both the expected results and other points within an underwriting classes expected loss distribution [½]
- Changes in claims handling procedures may introduce process uncertainty in reserve risk [½]
- Bodily injury claims [½]

- Changes in third party behaviour could introduce process uncertainty in any risk area depending on where the insurer uses third party [1/2]
 - Changes in legislation: Liability products tend to be heavily impacted by legislation changes and so this will be a key source of process uncertainty [1/2]
 - For example the change in Ogden rate for bodily injury claims had a big impact of many motor insurers capital. Mark given for other valid example. [1]
 - Offshoring [1/2]
 - Uncertainties in expenses such as levies could introduce process uncertainty in underwriting risk [1/2]
 - The position in the economic cycle and the economic conditions will impact multiple risk areas as: [1]
 - ...It may mean that assets are less liquid resulting in difficulties settling claims. [1/2]
 - ...This is difficult to capture in a capital model as they generally look at specific time points rather than being continuous [1/2]
 - ...Liability lines of business are generally longer tail and so are more impacted by the discount rate which will be driven by economic variables [1/2]
 - Loss ratio results for liability lines tend to be very affected by the economic situation [1/2]
 - ...Particularly classes such as D&O and E&O which will tend to receive many more claims in adverse economic times [1/2]
 - Traditional monetary policy now not as effective at controlling the economy [1/2]
 - New types of investments [1/2]
 - Globalisation of investment markets will introduce process uncertainty in market risk. [1/2]
 - Influence of other investment markets [1/2]
 - Globalisation of insurance markets [1/2]
 - Regulation arbitrage [1/2]
 - New Markets: If liability is written in new markets, this is likely to result in increased process uncertainty due to the lack of available information that is likely to be available specific to this market (insurance risk) [1/2]
 - If the company is writing in multiple countries the exchanges rates are likely to have an impact, particularly due to their longer tailed nature. [1/2]
 - Changes in business mix [1/2]
 - New latent claims [1/2]
- Marks available for other sensible suggestions* [1/2 per point, Max 1]
Marks are not given for discussing uncertainty in building models, errors in inputting data, etc. [19, Max 8]

(ii)

Sensitivity testing

- This is where parameters are changed by a small amount to test the impact on capital [1]
- ...This is a way of assessing which parameters in the model need more care when parameterising and what is driving the capital result [1/2]
- ...More detailed reviews are likely to take place of those parameters identified as being as sensitive [1/2]

Stress testing

- This is where a single parameter is stressed materially to test the impact on capital in isolation [1]
 - ...These changes are more extreme parameter changes than sensitivity testing. [½]
- Scenario testing
- This is where multiple parameters are changed to test their impact [1]
 - ... Useful for considering combined effect of a number of a number of risks and cumulative effect of several different mitigating actions occurring at the same time [½]
 - ...The company may independently parameterise a scenario and compare this to model output [½]
 - ...This would be done to test if model scenarios are coming out at a similar return period to expert views [½]
- Reverse stress testing
- This would be experts coming up with a view of what would cause the business to cease to be viable and seeing if this is reflected by the model [1]
- Backtesting
- This involves comparing historic results to model outputs [1]
 - ...This is done to check the model is sufficiently reflecting the real world [½]
 - ...If there are 10 years of data and one is showing up as being a 1-in-100 result in the model then it is likely that the model parameterisation is not fully reflecting the real world unless there has been a material change recently [½]
- Adding and removing dependencies
- This would be done to test the importance of any dependencies within the model and to test if any material dependencies may have been missed out of the model [1]
- Benchmarking
- Comparing model outputs to benchmarks, e.g. industry results, other similar companies, other capital measures (e.g. statutory standard formulas) [1]
- Marks available for other sensible suggestions* [½ per point, Max 1]
[12, Max 4]

(iii)

Processes need to be in place so that:

- ...Changes in parameters are not missed or entered incorrectly into the model [½]
- ...Ensures that there is consistency of treatment and that all parts of the model get the level of review required and that no areas get insufficient attention [½]
- ...Ensures that everyone know what is required of them [½]
- ...Allows teams to track whether they will meet timescales and where they are relative to them [½]
- ...Reduces the risk of failing to comply with legislation / regulations [½]

Governance needs to be in place so that:

- ...The people signing-off parameters in an area are experts and have sufficient knowledge and authorisation to do so [½]
- ...Otherwise parameters may be selected that do not accurately reflect the real world [½]
- Governance give accountability to those responsible for parameters to ensure that sufficient care is given when they are considered [½]

- Where multiple sign-offs are required, it ensures that all experts view parameters as reasonable and reduces the risk that a single individual is unduly influenced / pressured to change a parameter away from their true view [1/2]
- [1/2 per point, Max 1]
[5 1/2, Max 2]

Marks available for other sensible suggestions

(iv)

Documentation mitigates risk as:

- ...Process documents allow sufficiently skilled people to take over the process if the current people are unable to for some reason [1/2]
- ...Technical documentation allows sufficiently skilled people to takeover running the model if the current team are unable to for some reason [1/2]
- ...Provides evidence to justify the reasons for selections of parameterisation and methodology [1/2]
- ...This is particularly useful if you are subject to validation or audits as these may happen a long time after selection [1/2]
- ...Ensures knowledge is not lost if people leave a company or move to new roles [1/2]
- ...Can serve as useful training material to get new staff up to speed [1/2]
- ...Ensures that everyone has the same understanding of the model, so that knowledge doesn't get forgotten over time [1/2]
- ...Provides a quick reference point to review previous decisions so that time isn't wasted repeating past work. [1/2]
- ...Reduces the operational risk that a process isn't followed correctly and the potential consequences of that [1/2]
- ...Increases transparency which reduces the risk that mistakes are made due to difference in interpretations. [1/2]
- ... provides clarity around communication [1/2]
- ... regulatory risk reduced [1/2]
- ... can be used to ensure limitations are fully understood [1/2]

[1/2 per point, Max 1]
[7 1/2 , Max 2]

(v)

- The main output of a capital model are financial statements which are used to tell a company how much capital they must hold [1/2]
- Different accounting bases will result in different financial results which would result in a change to capital requirements [1/2]
 - ...For example an accounting basis that works on an earned basis would give a very different result to one on a written basis [1/2]
- ...Some accounting bases could show a loss when another would show a profit. [1/2]
 - ...For example if acquisition costs were forced to be accounted for when the policy is written on one basis but could be smoothed over the life cycle of a policy on a different basis then a growing company would experience a very profitable result. (Mark given for other valid example) [1/2]

Importance for model use

- If a company wished to use a capital model in its business, e.g. for business planning, then it needs to use an accounting basis that is consistent with its own accounts [½]
- ...If it uses a different accounting basis then it may make decisions that would be advantageous on the capital model basis but are not using their financial reporting accounting basis. [½]
- ...Or may have been less advantageous than an alternative options. [½]
- If the capital model is approved for setting regulatory capital, the regulator may not be happy that a different accounting basis is used than the one on which the business is run [½]
- ...Or on a different basis to one that they have prescribed. [½]
- If within a country that requires a report on Own Risk and Solvency view (or some form of report for a rating agency), then it will be important to explain why a different basis has been chosen. ORSA is a specific Solvency II term, but other regimes also require similar reports and a mark should be given for other valid examples. [½]

Impact on inputs

- Accounting basis may impact...
 - ... how the model is set up [½]
 - ... the granularity of inputs required [½]
 - ... will change the values selected for the inputs [½]

Other General Points

- However if multiple entities are modelled, it may not be possible to produce reports on all of the different accounting bases used [½]
- Accounting basis also changes the amount of available capital and hence the amount and type of assets that are modelled may need to be changed. [½]
- Will want to use a consistent basis over time [½]

Marks available for other sensible suggestions

[½ per point, Max 1]

[9½, Max 3]

[Total 19]

Well prepared candidates scored highly on both (i) and (ii).

Generally candidates struggled with (iii), (iv) and (v) which was disappointing as these higher order questions address important areas of capital modelling. For (iii) and (iv) it appeared that some candidates had missed that the question asked how risk was mitigated and instead listed examples of processes, governance and documentation. Candidates who correctly identified that the question asked how often struggled to generate points beyond regulatory requirements. Part (v) was generally the worst answered with a large number of candidates scoring zero.

7(i)

- Assess reserve adequacy in absolute and relative terms. [½]
- ...Some companies may hold precautionary margins in their reserves for one or more reasons, from regulation to prudence. These margins may be explicit or implicit. By examining claim variability, we can provide management with information as to the strength of the reserves. [½]
- Compare the reasonableness of different sets of reserve estimates. [½]
- Compare datasets at different as at dates. [½]
- Monitor performance to see if claim movements are material. [½]
- Allocate capital. Quantifying reserving risk is a key component of insurance companies' capital models. [½]
- Inform the management / Board of the insurance company to assist with ongoing decision making. [½]
- ...for example in what areas to expand or contract the volume of business being written. [½]
- Informed discussions with regulators. [½]
- ...Adverse run-off movements can impact the solvency of a company. Regulators are interested in gaining a better understanding of the run-off risk. To this end, regulations tend to require more explicit disclosure of information concerning variability. [½]
- Price insurance and reinsurance policies. [½]
- Provide information to investors. [½]
- ...From an investor perspective, understanding the uncertainty in claims reserves helps to compare the relative attraction of two different investments. To assist investors, accounting rules tend to require more explicit disclosure of information concerning variability. [½]

Marks available for other sensible suggestions

[½ per point, Max 1]

[7½, Max 3]

(ii)

Three simulation methods – Bootstrapping, Actuary-in-the-box, Recognition or Emergence
Pattern methods

Bootstrapping

- involves sampling (with replacement) multiple times from an observed database to create a number of pseudo datasets [1]
- ...We can then refit the model to each new dataset and obtain a distribution of the parameters [½]
- ...For reserving it can be applied to an ODP model, where we assume that the incremental claims follow an ODP distribution [½]
- ...Bootstrapping can also be applied to Mack's method [½]

Key assumptions include

- ... the run-off pattern is the same for each period [½]
- ... incremental claims amounts are stochastically independent [½]
- ... the variance of the incremental claims amounts is proportional to the mean [½]
- ...incremental claim amounts are positive for all development periods [½]

[4½, Max 2½]

Actuary-in-the-box

- begins with a best estimate of the reserves at the start of the year (say using Chain Ladder method) giving a set of Ultimates. [1]
 - ... Next, simulate the next year's claims paid development using any suitable technique [1/2]
 - ...Re-apply the chain ladder method on this triangle with an additional year's paid data giving another set of Ultimates [1/2]
 - ...Subtracting the two sets of Ultimates over the period give us either a run-off surplus or a run-off deficit for the next year. [1/2]
 - ...Repeating the steps multiple times will give us a full distribution of the run-off result for future periods. [1/2]
 - Require algorithm to be repeatable without subjective input [1/2]
- [3½, Max 2½]

Emergence Patterns

- can be used to estimate the reserve risk over one-year horizon when the ultimate reserve risk has been estimated or derived from external sources [1]
 - ...The method relies upon being able to estimate the proportion of ultimate reserve risk that will emerge over the next year [1/2]
 - ...A stochastic payment pattern might be used to estimate this proportion [1/2]
- [2, Max 1]
[10, Max 6]

(iii)(a)

LN mean = 100,000 based on table [1/2]

CoV = 20% - means S.D. = 20,000 [1/2]

Variance = 400,000,000

Let us say the reserves follow $X \sim \text{LN}(\mu, \sigma^2)$

Then we are given that mean = $\exp(\mu + \frac{1}{2}\sigma^2) = 100,000$ [1/2]

And variance = $\exp(2\mu + \sigma^2) * (\exp(\sigma^2) - 1) = 400,000,000$ [1/2]

Solving (dividing variance by the square of mean) [1]

$\sigma = 0.19804, \mu = 11.4933$ [1]

[Total 4]

(iii)(b)

This means $\log X \sim N(11.4933, (0.19804)^2)$ distribution

Let A be the required reserve at 75th percentile.

Using 75th percentile point for Standard Normal as 0.6745 [1/2]

$(\log A - 11.4933)/0.19804 = 0.6745$ [1]

Solving A = 112,070 [1/2]

[Total 2]

(iv)

- For the book SSL writes, it is primarily liability and has a high potential for latent claims [1/2]
- The company has been writing business only for 6 years which is relatively short to see latent claims in the triangles [1/2]
- ... or other extreme scenarios [1/2]

- ... given the size, there may not even be data for a deterministic model [½]
- Equally Liability book can be quite volatile in general [½]
- ...and long tailed [½]
- ...Employer's liability, for example, can sometimes take a long legal process to establish responsibility [½]
- ...and 6 years of data might not capture this volatility [½]
- Stochastic reserving methods only simulate the claims already presented in the triangles [½]
- ...They will not capture the variability from other volatility, i.e. Events Not In Data [½]
- As the company has not been going for many years, there is likely to have been a change in mix in the experience to date [½]
- ... so can't expect stable patterns [½]
- As a small syndicate, may only follow other syndicates and so may not fully understand the business [½]
- Or may be exposed to a mix of different reserving philosophies [½]

Marks available for other sensible suggestions [½ per point, Max 1]

[8, Max 4]

[Total 19]

Better prepared candidates tended to do well on this question, although the response to different parts of the question was variable.

Part (i) was generally well answered.

For (ii), many candidates appeared to have missed that the question specifically asked for simulation methods and so did not score as well as would have been expected for a bookmark question.

Part (iii) tended to result in candidates either scoring very highly or lowly.

For (iv), the key was to focus on the portfolio written and many candidates wrote generic points that therefore did not generate marks.

8(i)(a)

Available capital

- The amount of allowable assets a company is holding in excess of its liabilities [1]
 - ...This may differ depending on the regime / accounting bases that is being used [½]
- [1½, Max 1]

(i)(b)

Regulatory capital

- This is the amount of capital that the regulator requires you to hold in order for it not to intervene in business activities [1]
- ...Some regulators may have multiple levels of capital requirement, with different levels of intervention occurring at each [½]

[1½, Max 1]

(i)(c)

Economic capital

- This is companies view of the amount of capital that it must hold in order to meet its own risk appetite / fulfil its own objectives [1]
- This is distinguished from other measures in that it matches the full range of the insurers objectives. [½]

[1½, Max 1]

(i)(d)

Required capital

- This is the amount of capital that an insurer needs. This will depend on the economic capital, the regulatory capital, rating agency requirements, shareholder or debtor requirements, etc. [1]
- A typical exercise will link a measure of required capital to a desired level of loss absorption ability [½]

[1½, Max 1]

[6, Max 4]

(ii)

Company A:

- Capital is driven by catastrophe risk [1]
- As only impacted by catastrophe losses, this suggests that this is the only type of business they write [1]
- Or that the company has fully reinsured all other types of losses. However the small movement caused by increasing the likelihood of counterparty default suggest that this is not the case [1]
- In order to only write catastrophe losses, the company must be a reinsurer as there is no demand by original insureds to purchase policies at this level [1]
- As the increase in catastrophe losses is larger than the increase in exposure it suggests that the company has reinsurance / retrocession on its own exposure and that a 10% increase in exposure it has blown through its reinsurance programme [1]
- Conclusion: Catastrophe Reinsurer [½]

Marks available for other sensible suggestions

[½ per point, Max 2]

[7½, Max 4]

Company B:

- This line of business appears to have low attritional volatility as doubling the volatility doesn't have much more impact than increasing it by 10%. [1]
- There is not much change on a large loss basis which suggest that this class doesn't experience a lot of large losses. [1]
- Catastrophe loss appear to influence the tail losses which suggest this may be a property class. [1]
- Most motor property damage claims are fairly predictable for attritional and so have low volatility. [1]
- Reinsurance credit risk change results in no change which could suggest the company has no reinsurance or that the reinsurance is with very secure entities that fail above the selected return period [1]
- Conclusion: Any Property Damage class [½]

Marks available for other sensible suggestions

[½ per point, Max 2]

[7½, Max 4]

Company C

- Attritional losses for company seem to have a large volatility as a small increase in volatility hasn't moved capital much but doubling had a much larger impact [1]
 - Suggests attritional losses may not be driving capital but large losses are [1]
 - Given the large increase for severity changes, it is likely that either the company is close to its reinsurance limit or does not have much reinsurance [1]
 - Reinsurance credit risk change results in no change which could suggest the company has no reinsurance or that the reinsurance is with very secure entities that fail above the selected return period [1]
 - Large change for increase in frequency may also suggest that the frequency of large losses are not viewed as being independent [1]
 - There doesn't appear to be any natural catastrophe exposure which suggests that it is unlikely to be a property class or is written in an area that isn't affected by catastrophes [1]
 - Conclusion: Any Liability class [1/2]
- Marks available for other sensible suggestions* [½ per point, Max 2]
[8½, Max 4]

If suggestions of classes of business have not been made, max mark available is 8½.

Marks can be given for classes other than those in mark scheme as long as they have been sufficiently argued and justified. [23½, Max 10]

(iii)

- The purpose of the capital allocation exercise is an important consideration as it should drive the decision on the capital allocation method used [½]
- ...This could be an exercise in allocating cost of capital to different lines of business to calculate target combined operating ratios (or loss ratios) [½]
- ...Or it could be an exercise to look at changing mix or adding a new class when doing business planning [½]
- Decision as to which type of capital measure you are going to be allocating out [½]
- ...For example if using the capital allocation for pricing are you interested in allocating out the cost of capital you have to put up on a regulatory basis [½]
- ...Or would you want to look at it on an economic capital basis as this is your true view of this class [½]
- Method used for allocation could use a point estimate or a measure that looks over a range of simulations [½]
- e.g. VaR, TVaR, etc. [½]
- It is important to consider the mix of lines of business: [½]
- ...Europe and US property business may contain catastrophe losses that could potentially be large and drive the more extreme events and so contribute more to the tail of the distribution but less so to the main body [½]
- ...Movable property is likely to be more predictable and so may drive the main body of the losses but not the tail losses [½]
- ... Extended warranty will have some tail [½]
- ...As a result the return period selected could materially change the capital allocated to classes due to losses from different classes being drivers of different parts of the loss distribution [1]

- ...A blending approach between multiple return periods may wish to be considered in order that the property class doesn't have all of the capital allocated to it which would make it unviable [1]
 - Desirable properties of capital allocation [½]
 - Correlations and dependencies between classes [½]
 - Different methods available to use [½]
 - Half mark for giving examples [½]
 - Consider any new methods available [½]
 - Different methods may be used to calculate and allocate capital [½]
- Marks available for other sensible suggestions* [½ per point, Max 1]
[12, Max 4]

(iv)(a)

General Comments

- Consider alternative covers [½]
- Consider using stochastic variable for the reinsurance programme in the capital model to identify an optimal structure [½]
- How post tax profit varies [½]
- Impact on return on capital of different programmes [½]
- Risk appetite of insurer [½]
- Alignment of existing programme to the business [½]
- Capital benefit of program [½]
- May look at programmes individually or as a collective [½]

Covers across multiple classes

- Consider how costs and recoveries will be allocated where reinsurance covers many classes within an entity. [1]

Non-proportional specifics

- Analysis of impact and incidence of large claims for Risk XL programmes: [1]
- ...these are mainly likely to be on the property business but could exist on others [½]
- ...The insurer may wish to look at its historical experience of large claims to assess if it has enough reinstatements on its reinsurance programmes [½]
- ... and the associated reinstatement costs [½]
- ...If the company is regularly close to exhausting its programmes then it may be that it is still exposed to a large amount of volatility as it will be likely to completely exhaust the programmes in adverse years and so the poor experience will fall into its net results [1]
- ...However this should be considered in the context of the company's risk appetite and strategy as reinsurance purchase may be focused around regulatory capital efficiency and smoothing near term profit results. [1]
- ...It is worth considering that if a company is regularly utilising its reinsurance then the programme cost is likely to increase in future years as reinsurers exist to make a profit. [1]
- ...The insurer will also want to make sure that it isn't under-utilising a policy [½]
 - ...For example if rarely or never receiving any recoveries it may be that the excess of the policy is too high. [½]

- ...The insurer should also check that they do not have a limit that is larger than the maximum line size they intend to write (assuming a LOD policy) [½]

Potential Aggregations of risk

- Analysis of concentrations and aggregations of risk within their portfolio: [½]
- ...For Property insurance, it is likely that an insurer will want to look at aggregations of risk within location as it is within catastrophe exposed geographic locations. [½]
- ...Here it would want to compare its exposure in these locations to its catastrophe XL programme to decide if it has sufficient limits to cover the return periods in its risk appetite statement but not so high that it is buying cover that it won't be able to use [1]
- ...It would also want to check that its excess is in line within its risk appetite and isn't too low that the programme becomes expensive or too high that it has more exposure than desired. [1]
- ...Reinstatements will also be important here to ensure that the company has sufficient sideways cover and firms may be more exposed to multiple events occurring than very large events happening if they have high limits. [1]
- ...There may also be aggregations of risk in extended warranty if the company is focussing on a particular type of product and it is discovered that certain parts used in products wear out much faster than originally thought so the insurer may purchase cover to protect against this aggregation of risk. [1]
- ...However this may not be the case if the insurer thinks that it could sue the part provider of the product for some reason. [½]

Proportional reinsurance

- The company may wish to do an analysis of expenses and profitability if it has quota share insurance to assess if it is receiving adequate return commission to cover this [1]

Likelihood of default

- An investigation looking at the credit rating strength should be carried out [½]
- ...This would involve looking at the likelihood of current reinsurers defaulting and alternative options available in the market, such as other reinsurer's credit ratings, collateralised reinsurance or alternative market solutions [½]
- ...This is key as reinsurers are likely to be most relied on in extreme circumstances which is also when the reinsurer is likely to be under the biggest financial strain [½]

Excess cover

- The insurer should check that they have not brought more 100% coverage of any layer of an XL programme as it is unlikely in practise that they will be allowed to claim recoveries that are more than the gross claims incurred. [1]
- ... or that they have brought covers when the maximum benefit is greater than the potential loss [½]

Some other practical tests may also include:

- ...Testing capital impact of including or removing a reinsurance programme or layer [½]
- ...Looking at the probability or return period that each XoL layer starts being used and the probability of it being exhausted [½]

...Looking at the expected reinsurer loss ratio at the mean at a number of interesting probabilities. [½]

Marks available for other sensible suggestions [½ per point, Max 1]
[2½, Max 5]

(iv)(b)

- Investment: assessing the impact of a change in the investment mix. ½
- Pricing: assessing return on capital for pricing ½
 - ... and performance measurement. ½
- Reserving: quantifying the uncertainty in claims reserves. ½
- Planning: comparing different plans in terms of their risks, not just expected profits. ½
- Strategy: assessing the risks and diversification benefit of new strategies. ½
- Risk management: identifying key risks and assessing the impact of mitigation. ½
- Calculating regulatory capital requirement ½

Marks available for other sensible suggestions [½ per point, Max 1]
[5, Max 2]

[Total 25]

[Paper Total 100]

This questions was generally well answered, with most candidates being able to generate points in most parts.

END OF EXAMINERS' REPORT