

# **INSTITUTE AND FACULTY OF ACTUARIES**

## **EXAMINATION**

**11 APRIL 2018 (am)**

### **CA2: Model Documentation, Analysis and Reporting**

#### **Paper 1**

Time allowed: 3 hours + 15 minutes reading time

#### **INSTRUCTIONS TO THE CANDIDATE**

1. You have 15 minutes reading time at the start of the examination in which to read the questions. You are strongly encouraged to use this time for reading only, but notes may be made. You then have 3 hours to complete the paper.
2. You must build your model from the beginning and not use an imported e-template.
3. At the end of the examination you have 5 minutes to upload your submission.

Your file names must include your ARN, the name of the document and the paper sat (e.g. 9000000-Summary-Paper1) and each file should contain your ARN as a header or footer.

Please note that the content of this booklet is confidential and students are not to discuss or reveal the contents under any circumstances nor are they to be used in a further attempt at the exam.

If you encounter any issues during the examination please contact Examinations team  
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## Exam requirements

1. Read the background document, which describes the scenarios that need to be modelled and documented for this project.
2. Construct a spreadsheet model which produces the following calculations and charts. You should ensure that your spreadsheet contains appropriate self-checks and that you have performed and documented robust reasonableness checks at each stage of your calculations.
  - (i) Calculate the following for General Insurance Ltd (GIL) as at year end 2017:
    - (a) Required Capital [4]
    - (b) Own Funds [4]
    - (c) Solvency Ratio [1]
  - (ii) Construct a chart which shows the percentage of the total Required Capital that is attributable to each of the four components, namely premiums for motor business and property business and to reserves for motor business and property business. [3]
  - (iii) Calculate the Solvency Ratio, including the Counterparty Capital, if GIL had a 50% quota share reinsurance treaty for 2018. [4]
  - (iv) Determine if it is possible to achieve a target Solvency Ratio of 140% by reinsuring a portion of only the motor business with a quota share arrangement, and if so, the percentage quota share needed. [3]
  - (v) Project GIL's Solvency Ratio up to year end 2021 based on the information provided by the Finance and Actuarial Departments. [5]
  - (vi) Illustrate the projected Own Funds and Required Capital figures and the Solvency Ratios from part (v) using a suitable chart or charts. [3]
  - (vii) Determine the dividend pay-out ratio required so that the projected Capital Ratio for year end 2021 is equal to the target ratio of 140%. [3]

**Note: all scenarios outlined above should be modelled separately within your spreadsheet. The user should not need to change the parameters to see the results.**

### Marks available for spreadsheet model and checks:

Accurate completion of above modelling steps	[30]
Demonstration of good modelling technique and practice	[7]
Checks	[8]

**[Sub-total 45]**

**3** Produce an audit trail for your spreadsheet model which includes the following aspects:

- purpose of the model
- data and assumptions used
- methodology, i.e. description of how each calculation stage in the model has been produced
- explanation of the checks performed

You should ensure that your audit trail is suitable for both a senior actuary, who has been asked to approve your work, and a fellow student, who has been asked to peer review and correct your model, or to continue work on it, or to use it again for a similar purpose in the future.

**Marks available for audit trail:**

**Audit approach**

<b>Fellow student can review and check methods used in the model</b>	<b>[8]</b>
<b>Senior actuary can scrutinise and understand what has been done</b>	<b>[8]</b>
<b>Written in clear English</b>	<b>[4]</b>
<b>Written in a logical order</b>	<b>[3]</b>

**Audit content**

<b>All steps clearly explained</b>	<b>[7]</b>
<b>Clear signposting included throughout</b>	<b>[5]</b>
<b>Statement of assumptions made</b>	<b>[5]</b>
<b>All model steps accurately covered</b>	<b>[15]</b>

**[Sub-total 55]**

**[Total 100]**

## Background

General Insurance Ltd (“GIL”) is a medium sized insurer writing motor and property insurance for individuals. The regulatory solvency regime in the country in which GIL operates has recently changed. GIL must calculate its solvency position annually and also produce a solvency projection for its Board of Directors.

Also all insurance companies are required to produce an Own Risk and Solvency Assessment (“ORSA”) at least annually. The ORSA must compare the current solvency ratio to a specified target minimum. If the current solvency ratio is less than the target the ORSA must show how the target could be achieved, for example by using reinsurance. Companies must also project their solvency position into the future to demonstrate there is sufficient capital to maintain the target minimum solvency ratio over the next four years, which is the period covered by GIL’s business plan.

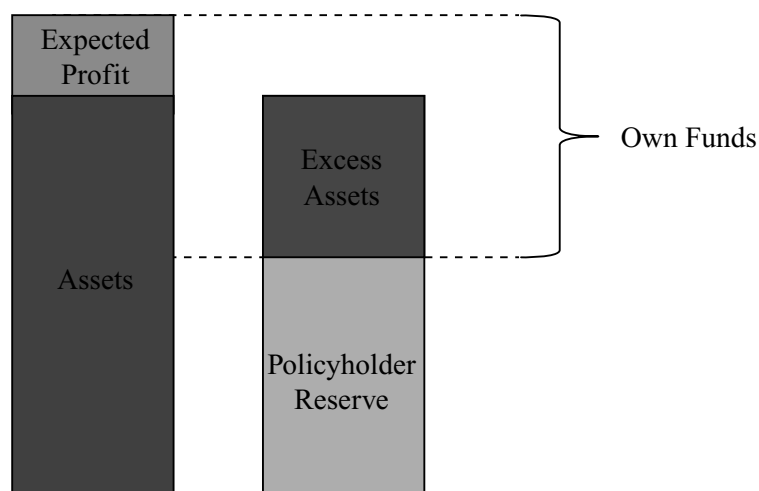
You are an actuarial student working in the risk management department at GIL. The Chief Risk Officer (“CRO”), a qualified actuary, has asked you to provide assistance in calculating GIL’s Solvency Ratio and to perform additional analysis for the ORSA.

### Solvency regime details

The local regulator has published the following details about the country’s solvency regime:

- All insurance companies are required to hold additional capital on top of their policyholder reserves in case of poor experience.
- For the purposes of determining whether an insurance company has sufficient capital an insurer’s surplus in excess of policyholder reserves is calculated and this is referred to as “Own Funds”. Own Funds is calculated as “Excess Assets” plus “Expected Profit” as shown in the diagram below. Excess Assets are the excess of assets held over the policyholder reserve. Expected Profit is the expected profit margin to be earned on the following year’s net expected premiums.

**Own Funds Graphic**



- All insurers are required to hold Own Funds of at least 100% of a minimum amount referred to as Required Capital. The Required Capital for an insurer is calculated annually according to the formula set out as follows:

Premium Risk Capital = sum over all lines of business of next year's expected premium (net of reinsurance if any) multiplied by a solvency capital premium percentage for that line of business

Reserve Risk Capital = sum over all lines of business of the year end reserves multiplied by a solvency capital reserve percentage for that line of business

Required Capital = Premium Risk Capital plus Reserve Risk Capital

- The ratio of the insurer's Own Funds to its Required Capital is referred to as the Solvency Ratio.
- The regulator expects that insurers have a Solvency Ratio in excess of 100%. The exact level of Solvency Ratio is for the individual insurer to decide, but the regulator has asked that all insurers target a Solvency Ratio appropriate for the risks in the insurer's business. There are therefore ongoing discussions between the regulator and the insurers about the appropriate target solvency ratio for the business.

GIL writes two lines of business, namely motor insurance and property insurance. Each line of business has solvency capital percentages prescribed by the regulator for both net premiums and reserves as shown in the table below.

The Finance Department at GIL has provided you with the following table which sets out for each line of business the information needed to calculate the solvency ratio. Also they have told you that GIL's Excess Assets as at 31 December 2017 is \$60m. The Expected Profit for 2018 will be the profit margin percentages for each line of business multiplied by the corresponding expected premiums for 2018.

**Table 1**

	<i>Motor</i>	<i>Property</i>
Policyholder reserves @ 31/12/2017 (\$m)	80	10
Expected Premiums 2018 – (\$m)	60	20
Solvency Capital Percentages		
– Premium	30%	45%
– Reserves	42%	21%
Profit Margin % of Earned Premium 2018	10%	30%

Using this information, the CRO has asked you to calculate the following:

- The Required Capital for GIL as at year end 2017.
- The Own Funds calculated as the Excess Assets plus the Expected Profit to be made in 2018.

- The Solvency Ratio as at year end 2017 calculated as Own Funds divided by the Required Capital.

### **Target Solvency Ratio – Reinsurance**

The Board of Directors for GIL, together with the regulator, has reviewed the Solvency Ratio which was calculated at year end 2017 for GIL. The regulator is concerned that the current value is too low and the Board has asked the CRO to target a higher solvency ratio. One potential solution is reinsurance and the CRO has therefore asked what the solvency ratio would be if 50% of the premium was reinsured through a quota share arrangement for 2018.

Under a quota share the reinsurer would receive 50% of all of the premiums and pay 50% of the claims. This would have the effect of passing half the business to the reinsurer so the net premium for GIL for 2018 would be 50% of the current expectation. There would be no impact on the business up to year end 2017 so there is no impact on the reserves held. The CRO does not believe that there would have to be any additional charges or margins passed to the reinsurer so, while the Profit Margin percentages will remain the same, the total Expected Profit for GIL would be reduced by 50% in line with the premium.

Under the solvency regime an additional solvency capital charge must be included in the Required Capital to reflect the counterparty default risk of the reinsurer. This additional charge is known as the Counterparty Capital, which is calculated as 2% of the premium paid to the reinsurer. The new total Required Capital equals this Counterparty Capital plus the Premium Risk Capital plus the Reserve Risk Capital.

### **Target Solvency Ratio – Reinsurance – Alternative Scenario**

The Board of Directors for GIL is keen to retain as much of the profits as possible for GIL so has asked that an alternative scenario is considered where only the motor insurance business is reinsured, and the property business is retained. The CRO has asked you to determine if it is possible to have a Solvency Ratio of 140% by reinsuring some percentage quota share of the motor business, and retaining 100% of the property business. If it is possible, he expects you to work out what percentage of the motor business for 2018 would need to be reinsured in the quota share.

### **Capital Projection**

The ORSA should also contain a projection of the capital position of the company over the period covered by the company's business plan, which for GIL are the four years from year end 2018 to year end 2021, ignoring any reinsurance. The business plan of GIL was prepared by the Finance Department and assumes that the premiums will grow over time. They forecast that premiums will grow annually by the rates given in Table 2 below. Also the Finance Department estimates that the policyholder reserves will increase annually by the rates set out in Table 2, based on an analysis of historic movements.

**Table 2**

	<i>Motor</i>	<i>Property</i>
Premiums	3%	7%
Policyholder reserve	6%	3.5%

The Finance Department has also told you that the current dividend policy of GIL is to pay out 50% of profits as a dividend annually. This should be reflected in your projection of the Excess Assets, where only 50% of each year's Expected Profit should be retained to increase the Excess Assets for the next year. So for example, the Excess Assets as at year end 2018 would be equal to the Excess Assets as at year end 2017 plus 50% of the Expected Profit as at year end 2017, which are assumed to be earned during 2018. Increases due to investment gains may be ignored.

### **Alternative Capital Projection**

Finally, the CRO would like to include in the ORSA the option of the company reaching a target Solvency Ratio of 140% at the end of 2021 by adjusting its dividend pay-out ratio, i.e. the percentage of profits paid as dividend. He has asked you to calculate the dividend pay-out ratio needed so that the forecast Solvency Ratio is projected to be 140% as at year end 2021.

Unfortunately, the CRO is out of the office and cannot be contacted for the next three hours. He would like the above calculations finished and documented in the audit trail ready for his return.

**END OF PAPER**