

INSTITUTE AND FACULTY OF ACTUARIES

EXAMINATION

23 April 2021 (am)

Subject SP9 – Enterprise Risk Management Specialist Principles

Time allowed: Three hours and fifteen minutes

<p>In addition to this paper you should have available the 2002 edition of the Formulae and Tables and your own electronic calculator.</p>
--

If you encounter any issues during the examination please contact the Assessment Team on
T. 0044 (0) 1865 268 873.

- 1** Red Bridge Company (RBC) is a family-owned company based in Country A. RBC specialise in public infrastructure projects including building roads, bridges and public buildings. RBC offers fixed prices for infrastructure contracts. For example, all bridges cost A\$8,000 per km. All of RBC's business is in Country A.

RBC invests in domestic government bonds and short duration corporate bonds. It also holds cash in a local bank.

Metal M is widely used in infrastructure and in the manufacturing industry as a component in many electrical goods. 10 years ago, Country A discovered it had sources of Metal M and the local economy has performed well as result.

Metal M derivatives such as futures are traded on the stock exchange in Country A.

- (i) Explain why RBC may wish to purchase Metal M futures. [3]
- (ii) Discuss the key risks to RBC of purchasing Metal M futures. [4]

RBC has grown rapidly in recent years and is one of the largest companies in Country A (by net value and employee numbers). RBC is now considering listing on the stock exchange in Country A. LMN Consultancy (LMN) has been auditing RBC for the last 7 years and LMN's audit partner is now good friends with the Chief Executive Officer (CEO) of RBC. The CEO asks LMN for advice on the potential stock exchange listing. LMN make several recommendations, including that RBC formalise its risk management framework by setting up a separate Risk Management Function (RMF), which will report to the firm's Chief Risk Officer (CRO), a new post reporting directly to the CEO.

RBC agree to recruit a CRO, but this will take many months. In the interim, the new RMF will be outsourced to LMN who will provide specialists in market risk and operational risk. They will set the risk appetite and write the risk management policies. Each quarter, they assess the effectiveness of the risk management controls against the risk management policies and report their findings to the CEO.

- (iii) Analyse the interim RMF structure including suggestions where improvements may be made. [6]

RBC propose to include a summary of the interim RMF in the published report and accounts.

- (iv) Discuss the relevance of the interim RMF to the key stakeholders. [6]

The failure of a large company in a neighbouring country has caused the regulator in Country A to investigate potential sources of contagion.

- (v) Explain why the regulator is concerned with contagion. [2]
- (vi) Describe the sources of systemic risk to RBC. [3]
- (vii) Explain how the failure of RBC could impact three different stakeholders, excluding the regulator. [3]

The regulatory financial control framework in Country A is similar to the Sarbanes–Oxley framework.

- (viii) Discuss the appropriateness of LMN’s relationship with RBC. [3]

The new CRO is concerned about possible extreme events and wants to discuss this with the CEO.

- (ix) Describe, with reference to an example that may impact RBC, what is meant by the term extreme events. [2]

The fixed price for bridge construction has not been reviewed in 5 years. It had been set using the average cost of previous bridge construction projects with a margin for profit and overhead expenses.

The table below shows the actual costs per km of the last 50 bridge construction projects:

<i>Bridge</i>	<i>Cost (A\$)</i>	<i>Bridge</i>	<i>Cost (A\$)</i>	<i>Bridge</i>	<i>Cost (A\$)</i>	<i>Bridge</i>	<i>Cost (A\$)</i>	<i>Bridge</i>	<i>Cost (A\$)</i>
1	7,640	11	6,154	21	5,152	31	6,881	41	5,195
2	7,950	12	5,749	22	5,675	32	8,118	42	5,976
3	4,717	13	8,765	23	6,409	33	10,824	43	5,376
4	3,175	14	3,256	24	2,654	34	9,040	44	5,414
5	9,503	15	6,978	25	4,404	35	9,125	45	6,531
6	3,001	16	5,809	26	6,616	36	6,517	46	6,565
7	2,946	17	6,867	27	5,617	37	2,617	47	1,626
8	7,059	18	7,964	28	2,554	38	2,424	48	8,882
9	3,239	19	3,851	29	5,678	39	4,450	49	8,321
10	3,057	20	2,288	30	2,298	40	6,034	50	8,777

The CRO believes that some high costs may be caused by extreme events previously discussed with the CEO and suggests the fixed pricing for bridge construction be revised to include an allowance.

- (x) Describe two possible approaches to fitting a distribution to the extreme values, using a different probability distribution for each. [4]

- (xi) Recommend, with reasons, which approach RBC should use to fit the distribution to the extreme values, including suggested values for the block size or hurdle. [3]

[Total 39]

2 An insurance company has an extensive branch network on the west coast of a large country. Each branch writes business in its local area. The company writes property insurance for individuals and corporations and has a large asset portfolio (primarily invested in term deposits, government bonds, corporate bonds and equities). It is increasingly concerned about its risk exposure to natural catastrophes (e.g. drought, wild fires, earthquakes). Specifically, it is concerned about the following risks and the correlation between these risks:

- underwriting risk exposure to natural catastrophes affecting the west coast
- damage to buildings and disruption to business operation when the insurance company's local branches are affected
- damage, loss and long-term financial strain the natural catastrophes cause to the companies in its asset portfolio.

Each branch uses its own risk taxonomy.

- (i) Discuss the implications of each branch using its own risk taxonomy for the above risks. [3]

The insurer implements one taxonomy across the company.

- (ii) Describe possible difficulties in modelling the correlation between the above risks. [3]
- (iii) Suggest, with reasons, the possible actions the insurance company could take to mitigate its risk exposures to natural catastrophes. [10]

The CEO of the company reads about the possibility of natural catastrophes becoming more frequent and consequent damages being potentially more severe. Therefore, the CEO asks for some scenario analysis to be conducted on the financial position of the company.

- (iv) Evaluate the use of scenario analysis to assess the financial impact of natural catastrophes on the company. [4]

The CEO also asks the Director of Investments for an overview of the risks for the insurance company relating to the asset portfolio. The CEO is also interested in understanding the insurance company's ability to fund promptly a large number of claims and other cash requirements from the business as they arise.

- (v) Describe how to assess the company's exposure to liquidity risk. [5]
- (vi) Outline the other risk exposures of the insurer arising from the asset classes held in its asset portfolio. [5]

The company's risk management policies for the risks outlined above include risk indicators that are regularly reported to the board. However, a liquidity risk indicator is not reported. Two proposals for liquidity Key Risk Indicators (KRIs) have been submitted:

- KRI 1: liquid assets/total assets
- KRI 2: claims/premiums.

(vii) Evaluate the proposed KRIs. [5]

(viii) Outline the components of the liquidity risk policy that may be covered by other risk policies. [3]

To ensure trading activities carry on as normal after natural catastrophes, the Director of Investments has put in place a procedure for certain traders to travel to a backup site, which is about 150 miles away from the trader's office. The site is maintained by a third party and meets the basic requirement of the traders from an IT infrastructure perspective. An annual test is carried out by a junior trader in the team to ensure that the site is functional.

The company is considering ways to improve the procedure that will better prepare the investment team for disruptions posed by natural catastrophes.

(ix) Suggest possible actions the insurance company could take to improve the procedure. [4]

[Total 42]

- 3 A life insurer has made substantial investments in corporate bonds to back long-dated annuity liabilities. The life insurer is considering developing its own economic capital model in order to model the insurer's exposure to credit default risk within the portfolio of assets backing its liabilities.

- (i) Explain why this insurer wants to develop its own economic capital model to model credit default risk. [5]

The insurer's Capital Actuary proposes using a survival model (time-until-default model) to estimate the default probability of individual bonds, and a copula to aggregate potential default losses at the portfolio level, with loss given default information from credit rating agencies.

- (ii) Write down the distribution function for the probability that a bond will have defaulted by time t . [1]

The Capital Actuary would like to use an implied default probability of 12% over a 20-year time horizon for BBB-rated bonds.

- (iii) Calculate the constant hazard rate under the time-until-default model. [2]

To start gaining an understanding of the tail, the Capital Actuary has produced the following Tail Value at Risk (TVaR) estimates, expressed as a percentage of the market value of the corporate bonds. Two methods were used in the assessment:

- Method 1: use data from the past 40 years and a Normal copula.
- Method 2: use data relating to economic recession periods only and a student's t -Copula.

	99.5% TVaR
Method 1	6.6%
Method 2	12.1%

- (iv) Compare the two methods used, including the possible reasons behind the differences in the results from the two methods. [5]

The Chief Financial Officer of the life insurer is interested in hedging the risks in the insurer's corporate bond portfolio. Two proposals are constructed by the investment team:

- Proposal 1: enter into Total Rate of Return Swaps (TRORS) at the portfolio level with a bank.
- Proposal 2: purchase a basket of Credit Default Swaps (CDS) from a handful of financial institutions.

- (v) Discuss the differences between the two proposals. [6]
[Total 19]

END OF PAPER