

INSTITUTE AND FACULTY OF ACTUARIES

EXAMINATION

28 September 2021 (am)

Subject SP9 – Enterprise Risk Management

Specialist Principles

Time allowed: Three hours and twenty 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>
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If you encounter any issues during the examination please contact the Assessment Team on
T. 0044 (0) 1865 268 873.

1 An entrepreneur decides to start an insurance operation, Optimising Insurance Limited (OIL). OIL exclusively focuses on participating in insurance deals globally that have already been underwritten by an insurer ('the underwriting leader'), or jointly by two or more insurers ('the underwriting leaders').

For example, OIL could take a 20% share of an insurance deal to cover the event cancellation risk of a pop music concert. It receives 20% of the premium and pays 20% of any payable claims.

OIL simply accepts the pricing level and terms and conditions set by the underwriting leader(s) and effectively outsources the claims handling function to them. In return, on a deal-by-deal basis, OIL pays the relevant underwriting leader(s) a fixed percentage fee (say 2%–5%) on the premium income and a share of any profit (say 15%–30%).

OIL expects to earn returns for its shareholders by a combination of the following:

- establishing and maintaining good relationships with the most capable insurers and becoming a reliable participant in large and lucrative insurance deals
- being selective about which deals to participate in and deliberating on how the portfolio of risk exposure fits together
- maintaining a low-cost base and use technology to make the operation scalable.

OIL very quickly developed and signed off algorithms for policy risk and return evaluation, portfolio construction and ongoing monitoring. OIL has performed tests with several likely underwriting leaders and expects to obtain their data for its modelling purposes. The firm obtained necessary funding and licenses and decided to launch, initially fully retaining all the risks underwritten (i.e. without reinsurance).

After some initial analysis, the firm focuses on the following two business segments:

- event cancellation (relating to sports and music events)
- fire and flood insurance of commercial buildings.

The insured sums tend to be large (typically higher than \$1 million).

- (i) Describe the benefits of ERM to OIL. [3]
- (ii) Describe the risks specifically faced by OIL in its business venture, as a result of the way it has been set up, apart from the insurance risk associated with the business segments in which it intends to be involved. [9]
- (iii) Discuss the extent to which OIL can conduct robust quantitative analysis on its insurance risk. [5]

OIL has two managing directors (both reporting directly to the CEO), each focusing on one business segment. During the first 3 years of the business venture, the bonus of each managing director is calculated based on the amount of premium income generated for the relevant business segment and, from the fourth year, the bonus calculation is based on the profitability of the business they have each been generating. OIL has an independent business committee that sets the company's risk appetite and signs off every deal. The firm has also set up a central risk function, which focuses on risk quantification and monitoring.

- (iv) Comment on the above arrangement in the context of ERM best practices. [9]

Based on its funding positions and business volume projection, it has set a risk appetite of 1-year 99.5% Tail Value at Risk (TVaR) of \$350 million.

- (v) Describe the limitations of TVaR in the case of OIL. [2]

- (vi) Describe the advantages of TVaR relative to using VaR in OIL's situation. [3]

- (vii) Outline possible approaches to allocating capital across OIL's operations. [3]

- (viii) Discuss the advantages and disadvantages of the methods outlined in part (vii). [5]

Once it decided the types of risk to focus on, OIL began to acquire large amounts of historical data concerning these risks. It plans to use the data to gain a good understanding of the risks, so that it could decide on which deals to participate. In addition, it has tested ways to aggregate the risks from the two business segments.

- (ix) Discuss the use of scenario analysis and stress testing in this process. [3]

The risk function estimates that the probability of OIL making a loss in its event cancellation business is 0.04 and the probability of its commercial building insurance business making a loss is 0.16. To measure the correlation, it has estimated Kendall's tau to be 0.06.

- (x) Calculate the probability that both business segments make a loss, using the Clayton copula. [4]

- (xi) Discuss the appropriateness of OIL using the Clayton copula. [2]

An actuary has proposed to the business committee that OIL uses an algorithm to optimise its business portfolio. The algorithm has a module that evaluates the costs and benefits of purchasing reinsurance on certain policies. OIL is able and willing to obtain pricing easily from reinsurers for individual deals, and it has decided not to purchase reinsurance for its overall portfolio. OIL assesses that reinsurers typically charge 10%–15% more relative to the premium it typically charges.

- (xii) Propose, with reasons, how OIL could maximise its Return on Capital (ROC), including using reinsurance. [6]

- (xiii) Describe risks potentially introduced by the above ROC maximisation efforts and how to mitigate these risks. [4]

[Total 58]

- 2 A large insurance company has acquired an online-only small insurer, Nimble Insurance Incorporated (NII), which sells individual term life insurance and investment products. The plan is for NII to continue to operate as a separate brand, using its strengths in machine learning and other data analytics techniques and for it to also start selling other consumer insurance products with the financial backing of the new parent company.

The parent company, due to its limited online presence prior to the acquisition, is very nervous about NII's IT infrastructure and systems and has asked the company to take steps to further enhance it. NII is also adding an operational risk module to its capital model.

- (i) Describe a scenario analysis process for NII to model the operational risk. [3]
- (ii) Describe possible ways for NII to manage its operational risk. [4]

One product NII has been developing is a fixed-term savings product with a guaranteed rate of 3.0%, which is significantly higher than the market rate for fixed-term deposits. NII plans to use the premium to invest in corporate bonds, and by selecting bonds well (i.e. minimising default losses) and controlling the distribution costs, NII could make a modest profit after paying the guaranteed interest. NII plans to invest the premium in bonds with an average maturity that is 2 years longer than the term of the deposits, so that it can maximise the potential profit. It expects the product to experience very high retention rate and substantial sales growth.

- (iii) Discuss how NII could assess its liquidity risk exposure to this new product. [3]
- (iv) Discuss how NII could manage the liquidity risk introduced by the new product. [5]
- (v) Explain the concept of credit spread. [2]

NII uses the KMV model to calculate the individual bonds' credit risk, which will inform its construction of the bond portfolio. It then uses the credit migration model to assess the credit default prospect of its investment portfolios.

- (vi) Write down the formula to calculate the distance to default under the KMV model. [2]
- (vii) Describe the differences between Merton and KMV models. [3]

The following two tables provide key information to be used in assessing the default risk of investment portfolios:

Table 1: Global corporate average cumulative default rates (1981–2019) (%)

Rating	Time horizon (years)					
	1	2	3	4	10	15
AAA	0.00	0.03	0.13	0.24	0.7	0.91
AA	0.02	0.06	0.12	0.21	0.72	1.02
A	0.05	0.14	0.23	0.35	1.24	1.89
BBB	0.16	0.45	0.78	1.17	3.32	4.69
BB	0.61	1.92	3.48	5.05	11.78	14.67
B	3.33	7.71	11.55	14.58	23.74	27.12
CCC/C	27.08	36.64	41.41	44.1	50.38	52.59

Standard & Poor's '2019 Annual Global Corporate Default and Rating Transition Study'.

Table 2: Standard & Poor's average 1-year global transition rates (1981–2019) (%)

Initial rating	Year-end rating								
	AAA	AA	A	BBB	BB	B	CCC/C	D	NR
AAA	87.03	9.08	0.53	0.05	0.11	0.03	0.05	0.00	3.12
AA	0.49	87.21	7.74	0.48	0.05	0.06	0.02	0.02	3.92
A	0.03	1.66	88.42	5.04	0.27	0.11	0.02	0.05	4.40
BBB	0.01	0.09	3.37	86.32	3.51	0.44	0.10	0.16	6.00
BB	0.01	0.03	0.11	4.73	77.80	6.57	0.54	0.61	9.60
B	0.00	0.02	0.07	0.16	4.76	74.78	4.47	3.33	12.41
CCC/C	0.00	0.00	0.11	0.19	0.58	12.96	43.64	27.08	15.45

Standard & Poor's '2019 Annual Global Corporate Default and Rating Transition Study'.

(viii) Calculate, using the credit migration model, the expected default rate of NII's BBB-rated bond portfolio during a 2-year time horizon. [8]

(ix) Describe how NII could manage the credit risk of the portfolio without transferring it. [4]

NII decides to purchase a series of bespoke put options from Bank A to hedge its credit risk exposure. NII intends to purchase a put option every 6 months, with each corresponding to the bonds purchased during the previous two quarters.

(x) Describe other financial derivatives that could also reduce credit risk for NII. [2]

(xi) Discuss the practical issues involved for Bank A if it decides to dynamically hedge its own risks from writing these put options. [6]

[Total 42]

END OF PAPER