

INSTITUTE AND FACULTY OF ACTUARIES



EXAMINATION

1 October 2013 (am)

Subject ST9 – Enterprise Risk Management

Time allowed: Three hours

INSTRUCTIONS TO THE CANDIDATE

1. *Enter all the candidate and examination details as requested on the front of your answer booklet.*
2. *You have 15 minutes before 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 three hours to complete the paper.*
3. *You must not start writing your answers in the booklet until instructed to do so by the supervisor.*
4. *Mark allocations are shown in brackets.*
5. *Attempt all nine questions, beginning your answer to each question on a separate sheet.*
6. *Candidates should show calculations where this is appropriate.*

AT THE END OF THE EXAMINATION

Hand in BOTH your answer booklet, with any additional sheets firmly attached, and this question paper.

<p><i>In addition to this paper you should have available the 2002 edition of the Formulae and Tables and your own electronic calculator from the approved list.</i></p>
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- 1 Compare the data typically used for modelling credit risk with that for modelling operational risk. [7]

 - 2 Over the last few years the price of aviation fuel has generally been increasing, as has the volatility of the price of aviation fuel. In response, Snooze Air plc negotiated the purchase of forward contracts from an investment bank relating to the company's forecasted usage of aviation fuel over the following 18 months. Shortly after completing the purchase the price of aviation fuel has started to fall in response to a sharp downturn in the global economy.

 An Executive Director of Snooze Air has suggested that the negotiations required to extract the company from the forward contracts would take too long and has instead suggested selling futures contracts to mitigate the risk that the price of aviation fuel falls further.

 Discuss the advantages and disadvantages of the Executive Director's suggested mitigation strategy. [4]

 - 3 (i) Describe the various tools and techniques that can be used to identify risks. [5]

 ABC is an international charity funding medical research to develop cures for cancer and other terminal diseases. The charity has been set up so that all donations are paid into an endowment fund. This fund is invested to generate a real return that is in turn used to fund research grants.

 ABC has established a subsidiary management company, ABC ManCo, to administer the investments in the fund, to allocate the research grants and to meet all the other costs of running the charity. ABC ManCo earns its income by levying an annual management charge on the endowment fund.

 (ii) Discuss the extent to which this structure affects ABC's principal risk exposures. [4]

 The ABC endowment fund has been invested in a wide and diversified range of assets, including a prestigious commercial property portfolio. ABC ManCo currently leases its headquarters from a third party. As a number of the endowment fund properties are currently vacant, it has been suggested that it may be financially advantageous for ABC ManCo to move into one of these properties on a temporary basis.

 (iii) Discuss how this suggested arrangement could impact the risk profile of ABC. [4]

 (iv) Propose terms and conditions which could be included in the arrangement to help mitigate any additional risks for ABC. [2]
- [Total 15]

- 4 Island Life Insurance is a long-established composite (i.e. both life and general) insurance company which has grown organically and now has operations across the world.

Amongst its product portfolio is “coconut injury insurance”. This niche product is written on a short term (annually renewable) basis and provides a fixed lump sum payout to policyholders who have sustained an injury as a result of being hit by a falling coconut. In recent years the demand for this product has been steadily rising and Island Life is now the leading insurer in this market.

Part of Island Life’s competitive advantage with this product has been its ability to assess and price accurately the underlying risk. A sophisticated generalised linear model has been developed to estimate the likelihood of an injury occurring, taking into account a number of factors including the number of coconut trees in an area, population density and weather patterns.

As Island Life is headquartered in Europe, it will be subject to the Solvency II regulatory regime.

- (i) Assess the suitability of the Solvency II standard formula approach for the coconut insurance product. [5]

To maintain its competitive advantage, the Board of Island Life would like to minimise the capital requirements which must be met. It is therefore proposing to apply for internal model approval.

- (ii) Describe the six tests which an internal model must meet under Solvency II. [6]

To build on its dominance in this market, the Board is currently considering a new variant of the product. Instead of paying a fixed lump sum, the benefit will be on a full indemnity basis.

- (iii) Describe the additional risk modelling considerations for this new product variant. [5]

The Board would like to include this new product in its internal model application.

- (iv) Explain how this is likely to impact the ability of the insurer to meet the six tests. [3]
[Total 19]

- 5** Domestic Insurance is a life insurance company that sells a range of savings products, using domestic banks as the main distribution channel.

Although its assets are invested in a diversified portfolio across many classes, about 30% of the portfolio comprises government bonds. Of this, over two-thirds is in debt issued by the local government.

The Board has suggested that, for risk management purposes, the exposure of Domestic Insurance to sovereign default risk should be measured and monitored.

- (i) Outline the metrics and approaches which could be used to measure and monitor the sovereign default risk exposure of Domestic Insurance. [4]
 - (ii) Contrast the likely impact on Domestic Insurance of a potential default of either the local or foreign government bonds. [3]
- [Total 7]

- 6** (i) Define the terms economic capital and economic value. [2]

Company X is a life insurance company which uses an economic approach to support its enterprise risk management framework. Under this framework it defines economic profit as the change in economic value over the period.

- (ii) Comment on the use of economic profit as a key performance indicator. [4]

At the end of each year Company X carries out an analysis of the change in the economic value over the year. Under this process, each source of profit or loss is compared with the amount expected and allocated to a high level risk category (e.g. market, insurance, operational etc.).

- (iii) Discuss the advantages and disadvantages of presenting the economic profit in this way. [4]
- [Total 10]

Quantitative Logistics is an international parcel delivery business with a heavy reliance on technology. As a start-up, the competitive advantage of the company lay in its sophisticated quantitative model which allowed it to develop delivery routes which were quicker and more cost effective than those of established firms in the industry. Today, the company is a market leader in the industry with operations across the world.

The model works by describing the journey each parcel takes. Every parcel entrusted to the firm has to go through five different “states”. These are the receiving depot, the receiving distribution centre, the delivery distribution centre, the delivery depot and the end user. Each transition or journey between these “states” is then explicitly modelled taking into account the other parcels in the system, the transportation options available, the incremental cost of each option, the journey time agreed with the sender and the likely time each option will take. These are then aggregated using a copula approach. The model is run stochastically and a large number of simulations are considered in order to evaluate the optimal path for the delivery of the parcel.

In recognition of the importance of the model to the business, Quantitative Logistics has set up a Model Governance Committee which will have responsibility for the management and mitigation of model risk.

(ii) Describe the experience and expertise which the Committee as a whole should possess. [3]

(iii) Outline the activities that the Model Governance Committee should oversee. [4]

(iv) Discuss the role of the Internal Audit function in relation to the model. [2]

To help add flexibility and aid decision-making, a “short form” of the model has been proposed. This “short form” model will analyse the simulations from the full model using a form of regression analysis to describe each transition as a linear function of cost and time.

(v) Discuss the possible advantages and disadvantages of the proposed “short form” model. [5]

The Board of Quantitative Logistics is proposing to use “reputation at risk” as a new measure in its risk appetite statement. Under this measure, the company’s delivery times will be compared to those of its competitors. Whenever a competitor’s overall delivery time is shorter, Quantitative Logistics’ “reputation at risk” measure increases, with the increase being proportional to the delivery time difference.

(vi) Describe how the existing model could be developed in order to carry out a “reputation at risk” assessment for each parcel. [5]

[Total 20]

- 8** An investment company is analysing the likelihood of two corporate bonds defaulting and is trying to decide which copula to use to model their dependence structure.

Bond A has a probability of default in the following year of 0.05.

Bond B has a probability of default in the following year of 0.15.

You are given the following generator functions:

$$\text{Gumbel copula} \quad G_{\alpha} \Psi_{\alpha}(F(x)) = [-\ln(F(x))]^{\alpha}$$

$$\text{Clayton copula} \quad C_{\alpha} \Psi_{\alpha}(F(x)) = 1/\alpha \cdot [(F(x))^{-\alpha} - 1]$$

- (i) Calculate the probability of both bonds defaulting in the following year using:

(a) a Gumbel copula with parameter $\alpha = 2$

(b) a Clayton copula with parameter $\alpha = 2$

[4]

- (ii) Explain which copula would be more appropriate.

[2]

[Total 6]

- 9** A major heavy goods repair company has contracts with a number of suppliers on which it relies for the timely supply of quality parts at agreed prices. The chief buyer for the repair company has asked the group risk function if it can recommend changes to these contracts that will impose some aspects of ERM onto the suppliers, in order to improve and de-risk the supply chain. The changes have to be practical, proportionate and reflect the fact that the suppliers are unrelated third parties.

- (i) Suggest terms and conditions that should be included in the supply contracts.

[5]

Some input goods are very large, very expensive, take many weeks to manufacture and, whilst only needed rarely, are then needed very quickly.

- (ii) Outline the risks and costs that the company must consider when purchasing such goods.

[4]

- (iii) Describe ways in which the company could transfer or mitigate these risks and costs.

[3]

[Total 12]

END OF PAPER

