

EXAMINATION

30 April 2010 (am)

Subject ST9 — Enterprise Risk Management Specialist Technical

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 seven 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.

In addition to this paper you should have available the 2002 edition of the Formulae and Tables, the ST9 formulae sheet for 2010 and your own electronic calculator from the approved list.

- 1** XYZ plc is a large UK pharmaceuticals firm listed on the London Stock Exchange. Dr John Smith has worked for XYZ plc for 30 years. After starting as a laboratory technician, he was promoted to the main board ten years ago, becoming chief executive five years ago. Last year, the chairman of XYZ plc retired and Dr Smith added this role to his current responsibilities.

Because specialist knowledge is required to understand aspects of the business such as pharmacology and biotechnology Dr Smith insists that all board members be industry specialists. Given the sensitivity surrounding product development, Dr Smith rejects the inclusion of external directors, so all members of the board are either current or retired employees of XYZ plc. Dr Smith assesses the performance of the directors over a one-to-one lunch with each of them over the course of the year. He also agrees the directors' salaries at these meetings. To avoid conflicts of interest, the directors are not allowed to hold stock in XYZ plc.

Discuss ways in which the corporate governance of the firm could be improved. [6]

- 2**
- (i) Explain agency risk in the context of a non-managerial employee of a firm. [2]
 - (ii) Suggest ways in which this agency risk can be substantially reduced or eliminated. [2]
 - (iii) Describe possible constraints that would limit efforts to reduce this agency risk. [2]
- [Total 6]

- 3**
- (i) Explain the terms:
 - (a) Risk appetite
 - (b) Risk profile
 - (c) Risk limits
 - (d) Risk capacity
- [4]

A long established life insurance company has only sold conventional without profits life and health protection insurance to date. The company matches its assets and liabilities as closely as possible. The company is considering diversifying the business into savings by introducing unit-linked products.

- (ii) Describe how the Board might express risk appetite, including examples of key metrics, and how this would be translated into risk tolerances. [8]
 - (iii) Outline how the insurance company would use this to assess alternative strategies, such as whether or not to introduce unit-linked business. [3]
 - (iv) Describe the additional risks to which the insurance company will be exposed by introducing unit-linked business. [4]
- [Total 19]

4 You work for a general insurance company. The pricing actuary believes that the claims arising from the different lines of business might not be independent from one another. He plans to develop a correlation matrix based on Pearson's correlation coefficients. He suggests three possible approaches for adopting correlation coefficients between the various lines of business, namely:

- directly from the data
 - using estimates published by other actuaries for various lines of businesses based on various data sources over the years, and
 - subjecting his claims cost model to a range of possible correlation coefficient matrices
- (i) State with reasons the implicit assumption that the actuary is making about the distributions underlying the claims costs arising from the various lines of business. [3]
- (ii) Describe the pros and cons of the three different approaches suggested by the actuary. [7]

You are concerned that the pricing actuary's suggestions may not be the best way of estimating the dependency structure of the claims arising from the various lines of business. You suggest that the actuary calculates sample rank correlations for the purpose of parameterising a chosen copula.

You should assume that:

1. There are two lines of business, X and Y .
 2. The total claims cost for each line and for each quarter has been calculated over the past ten years to create a vector with 40 rows and two columns.
 3. The individual column vectors have been used to create $f(X)$ and $f(Y)$ continuous probability density functions.
- (iii) Describe Kendall's tau, including formulae, and its properties. [6]
- (iv) State the standard estimator of Kendall's tau parameterised for this particular case. [1]
- (v) Describe, including formulae, the use of the sampled Kendall's tau to calibrate a bivariate Archimedean copula with a single parameter. [3]

[Total 20]

5

ABC is a large insurance company specialising in writing immediate annuity business. To match the long term and regular payment nature of its liabilities ABC invests in fixed interest securities. To maximise the return on its investments and to improve the competitiveness of its pricing in the market ABC invests in corporate bonds as they typically earn a higher yield than government securities.

ABC's credit risk policy is that all bonds must be rated A or higher. If a bond is downgraded below A then it will be sold and the proceeds re-invested in an appropriate bond.

- (i) Comment on the nature of ABC's credit risk exposure and the effectiveness of its credit risk policy to mitigate these risks. [4]

ABC has decided to develop its own internal models to estimate the probability of default for each of the corporate bonds that it holds. It has opted to use the KMV model for this purpose in order to be consistent with the approaches used by the rating agencies.

- (ii) Outline the information needed to estimate the expected default frequency using the KMV model and suggest possible sources for this data. [7]
- (iii) Outline the advantages and disadvantages of using the KMV model for this purpose. [2]

For key individual bond holdings, such as that relating to Company DEF, ABC has decided to enter into a credit default swap (CDS) with Bank GHI.

- (iv) Describe how the cash flow arrangements would typically be structured under this CDS. [3]

It is often claimed that because of the long term nature of their liabilities, life insurance companies are able to extract a "liquidity premium" from their bond holdings that is not available to other investors. A member of ABC's Board has suggested that the extent of this premium could be estimated by deducting the cost of the CDS from the spread available on the bond.

- (v) Comment on the merits of this proposal. [3]
- [Total 19]

- 6** In Country Q all licensed banks are required to develop internal enterprise-wide capital assessment models. These models must be approved by the regulator. The regulator sets each bank's minimum capital requirement to be equal to the capital necessary to give the bank a 99.5% probability of having sufficient capital in the ensuing year. Unfortunately this system appears to have failed as one licensed bank has just declared bankruptcy, and the regulator is under some pressure to change the minimum capital requirement approach.

- (i) Discuss whether such a change would be an appropriate reaction. [5]

A politician has suggested that the various banks' internal capital models are far too complex and might easily fail to predict the range of foreseeable future outcomes. He has suggested that instead of setting capital at the 99.5% probability of sufficiency, capital should be set equal to five times the standard deviation estimated by the internal model.

- (ii) Discuss this suggestion. [7]

[Total 12]

- 7** A pension scheme has decided to change the interest rate and inflation rate profile of its asset portfolio. The trustees have received quotes from an investment bank for a series of interest rate and inflation rate swaps with the bank.

- (i) Describe the risks that arise for the pension scheme if it enters into this series of transactions. [4]

- (ii) Describe the steps that can be taken to mitigate these risks. [6]

The trustees note that the net expected investment performance of the asset portfolio including the series of swap transactions is lower than the net expected investment performance of a hypothetical equivalent asset portfolio with very similar interest rate and inflation rate profiles.

- (iii) Suggest reasons why the trustees might choose to trade the series of swaps rather than reposition the physical portfolio. [5]

- (iv) Explain an alternative approach that might meet the pension scheme's objectives and which would be less expensive than entering into the entire series of swap transactions as proposed. [3]

[Total 18]

END OF PAPER