

INSTITUTE OF ACTUARIES OF INDIA

EXAMINATIONS

November 2025

SP9 - Enterprise Risk Management

Time allowed: 3 Hours 15 Minutes

Total Marks: 100

- Q. 1)** *Jeevan Suraksha Samsthana (JSS)* is a life insurance company predominantly engaged in term insurance business, with a small proportion of business coming from other life insurance products.
- i)** Describe the most important risks JSS might face from its business as well as from its investments. (4)
 - ii)** Define legal risk. Explain any three ways in which it might arise, with an example relevant to JSS. (4)
 - iii)** The shareholders are nervous about operational risk not being adequately considered, addressed or managed. List some of the actions the insurer can take to manage operational risk it might be facing. With each action, also specify the type(s) of operational risk that it tackles and any residual risks it introduces. (10)
- The Board of Directors of JSS is considering setting up a Risk sub-committee. It is also considering getting JSS rated by a reputed credit rating agency (CRA) named Standard & Poor's (S&P).
- iv)** Why might it be a good idea to set up a Risk sub-committee? How should the Board go about setting it up? (5)
 - v)** Why might JSS consider getting itself rated by a CRA? (2)
 - vi)** What evaluation areas might S&P evaluate to assess JSS's ERM capability? How might this evaluation relate to the overall credit rating JSS might receive? (4)
 - vii)** Define risk appetite, risk tolerance and risk limits. Provide two (essentially different) example statements for each of them in the context of JSS. (7)
- As an actuary working at JSS, you are charged with modelling the inflation rate values using a time series process.
- viii)** Given the time series data and its correlogram, how would you determine the appropriate ARIMA model (i.e. its orders) to use? (5)
 - ix)** How would you test such a fitted model? (2)
- You are provided with an industry database of 2,981 operational risk losses and asked to build a model (call this model M1) for the size of losses (as a function of the characteristics of the event and the affected company).
- x)** Explain how the Likelihood ratio test (LRT), Akaike information criterion (AIC), and Bayesian Information Criterion (BIC) can be used to compare models such as M1. (3)
 - xi)** For a particular model, if the BIC exceeds the AIC by 60, find the number of independent variables in the model. (2)
 - xii)** For the large operational losses, you also wish to use the generalized Pareto distribution (GPD) for the excess loss distribution over a threshold. Call this model M2. What would be your approach and considerations while choosing the threshold and fitting the parameters for the GPD? (4)
 - xiii)** How do the models M1 and M2 compare as regards model risk? (3)

xiv) When modelling joint distributions, copula functions are often useful. An actuarial analyst in your team has listed some potential choices of copula functions. Identify, with reason, whether each of these is a valid choice for a bivariate copula function or not.

- A. $C(u,v) = uv$
 - B. $C(u,v) = u+v-1$
 - C. $C(u,v) = uv / (u+v-uv)$
 - D. $C(u,v) = \min\{u^2, v^2\}$
- (4)

xv) JSS estimates its daily Value-at-Risk as $2.5758 \cdot \sigma$ where σ is the expected 1-day volatility in the portfolio return. Stating all the likely assumptions underlying this estimation as well as any additional ones as necessary, derive an expression to estimate the weekly Value-at-Risk (assuming 5 working days per week).

(3)

In order to compute the capital requirements for JSS, the approach suggested by a colleague is as follows:

- The capital requirement at time t , denoted by $K(t)$, is evaluated as the difference between the value of assets, denoted by $A(t)$ and that of liabilities, denoted by $L(t)$, at that time.
- $K(0) = A(0) - L(0)$ is known with certainty, while $K(t)$ for $t > 0$ is an unknown random variable.
- To avoid ruin, we must have $K(t) > 0$ for all $t > 0$.
- To achieve the above, $K(0)$ is chosen large enough such that $\Pr[K(t) > kL(t)] = \Pr[A(t) - (1+k)L(t) > 0] \geq 1-\alpha$ where α is the risk tolerance and $k \geq 0$ is the comfort ratio.

xvi) State, with brief reasoning, whether the following changes will increase or decrease the required capital.

- A. Higher expected return on assets (relative to liabilities)
 - B. Higher volatility of assets (relative to liabilities)
 - C. Higher positive correlation between the asset and the liability values
 - D. Higher diversification in asset types constituting $A(t)$
 - E. Higher α
 - F. Higher k
- (3)

xvii) What are some of the challenges / limitations of the above approach?

(3)

xviii) Describe an alternative practical bottom-up process for calculating the capital requirements, including the specific considerations to be kept in mind.

(3)

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Q. 2) You, a qualified actuary, are at a Capacity Building Seminar on ERM as a Speaker. After your session, during the Networking Lunch Break, you are at a table surrounded by a curious and enthusiastic bunch of junior actuarial students. During your conversations with them, they happen to make following statements. For each of the following statements made, provide a detailed response:

- i) “ERM is simply ordinary risk management conducted centrally at the enterprise-level.”
 - ii) “ERM is generally only initiated in response to a previous risk management failure at the company.”
- (2)
- (2)

- iii) “If all investments of a company are denominated in a single currency (its domestic currency), it doesn’t face any foreign exchange risk.” (2)
 - iv) “Risk register is simply a list of all risks that a company might face.” (3)
 - v) “Whenever I need to measure the correlation / dependence between two quantities, I simply use the CORREL function in Excel. I hope that does the job well enough.” (4)
 - vi) “Risk sounds like such a bad thing. I don’t understand why someone would ever retain any of it!” (3)
 - vii) “Risk, like energy, can neither be created nor be destroyed. It can only be transferred from one entity to another.” (4)
 - viii) “To play it safe, I’d definitely keep my overall investment portfolio delta, gamma and vega neutral at all times!” (3)
 - ix) “There really is no point allocating capital to business units / regions within a company. The allocation is notional; the money stays within the company anyway.” (3)
 - x) “Even if a capital allocation is necessitated, it is best to do it in a simplistic / parsimonious manner, e.g. proportional to premium income by business unit.” (3)
- [29]
