

INSTITUTE OF ACTUARIES OF INDIA
EXAMINATIONS

17th September 2021

**Subject CM2B – Financial Engineering and Loss
Reserving (Paper B)**

Time allowed: 2 Hour (14.30 – 16.30 Hours)

Total Marks: 100

- Q. 1)** You have been given cumulative claims incurred from motor insurance company. It gives the amounts for each of the last nine accident years, and the related earned premium. The cumulative paid claims for all accident years since and including 2016 is Rs. 49,500.
- i)** Calculate average loss ratio, development factor and projection factor (f) upto 3 decimal places using Bornhuetter Ferguson method stating the assumptions you make. You do not need to make any allowance for inflation. (6)
 - ii)** Estimate the reserve required at the end of 2020 using the Bornhuetter-Ferguson method. (12)
 - iii)** You have now been given annual claim payments inflation rates for the 12 months, up to the middle of the year, for each of the years 2016 to 2020. You can assume all payments are made in the middle of each calendar year. Calculate inflation adjusted total liability. You should use the same method as you used in parts (i) & (ii). You do not need to allow for any inflation beyond 2020. (17)
- [35]**

- Q. 2)** A Gold miner wants to lease few acres of land in Karma Gold Field (KGF). The period of lease is 5 years. The lease is returned back to the owner at the end of 5 years.

The Gold miner can extract 1000 kgs of gold per year at a cost of ₹ 35 lakh per kg.

The current market price of gold is ₹ 40 lakh per kg and it fluctuates randomly in such a way that it increases each year by a factor of 1.2 with probability 0.75 or it decreases by a factor of 0.9 with probability 0.25. The force of Interest rate is 10% per annum.

It is assumed that any gold that is extracted in a given year is sold at the end of the year at the price that prevailed at the beginning of the year.

At the beginning of each year the Gold miner **decides whether to extract the gold** based on the price at that time.

- i)** Draw the binomial lattice of the Gold price for the next 5 years. (5)
- ii)** Estimate the value of the Lease (in crores of rupees) using the Binomial Model under the risk neutral measure. (17)

The gold miner has come to know that force of interest would not be constant but change for the next 5 years as below:

Year	0	1	2	3	4
Force of interest applicable for the next 1 year	10%	9%	8%	7%	6%

- iii)** Estimate the value of the Lease (in crores of rupees) using the Binomial Model under the risk neutral measure using the above information. (13)
- [35]**

- Q. 3)** **i)** Using the spot rates given in the excel sheet.

-
- a)** Calculate the one-year forward rates applicable at the beginning of each of the next 10 years. (2.5)
- b)** Calculate the Price of a zero coupon bond with face value of `100 maturing in 10 years' time at the beginning of each of the next 10 years. (5)
- c)** Draw a chart representing the yield curve using the information given above. (2.5)
- ii)** Using the parameters and the sample path given in the excel sheet, find the following:
- a)** Calculate the sample path of short rates from a Vasicek's model, under risk-neutral measure, for years 0 to 9 using "dt" as 1 year. (10)
- b)** Estimate & Tabulate the Yield curve based on short rates obtained above. (10)
- [30]**
