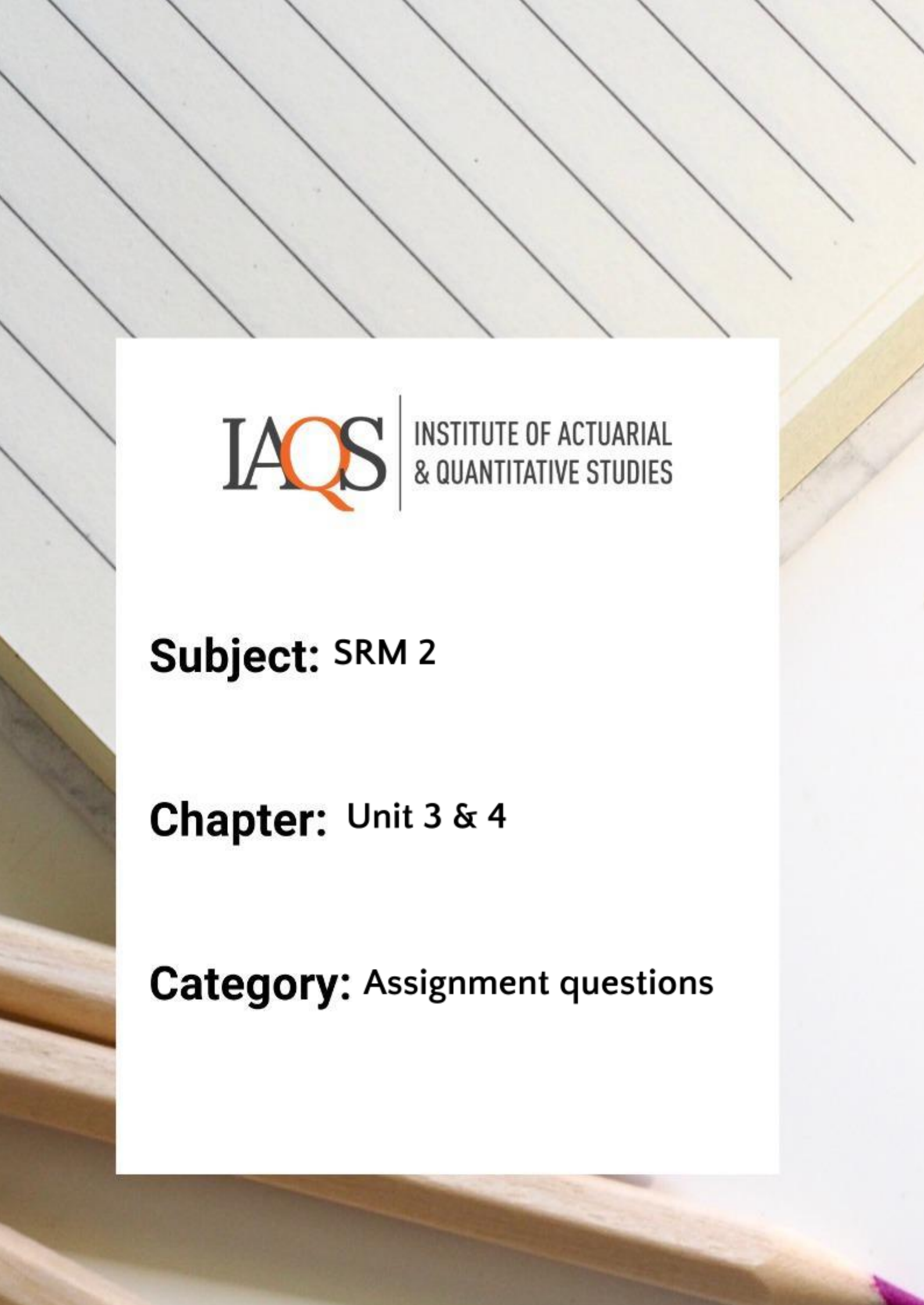

INSTITUTE OF ACTUARIAL & QUANTITATIVE STUDIES

Subject: SRM 2

Chapter: Unit 3 & 4

Category: Assignment questions

1. Claim events on a portfolio of insurance policies follow a Poisson process with parameter λ. Individual claim amounts follow a distribution X with density

$f(x) = 0.01^2 xe^{-0.01x} \quad x > 0.$

The insurance company calculates premiums using a premium loading of 45%.

(i) Derive the moment generating function $M_x(t)$.

(ii) Determine the adjustment coefficient and hence derive an upper bound on the probability of ruin if the insurance company has initial surplus U.

(iii) Find the surplus required to ensure the probability of ruin is less than 1% using the upper bound in (ii).

Suppose instead that individual claims are for a fixed amount of 200.

(iv) Determine whether the adjustment coefficient is higher or lower than in (ii) and comment on your conclusion.

2. Claims on a portfolio of insurance policies arrive as a Poisson process with parameter 100. Individual claim amounts follow a normal distribution with mean 30 and variance 5^2. The insurer calculates premiums using a premium loading of 20% and has an initial surplus of 100.

(i) Define carefully the probability of ruin ψ(100) , ψ(100,1) and ψ1(100,1) .

(ii) Define the adjustment coefficient R.

(iii) Show that for this portfolio the value of R is 0.011 correct to 3 decimal places.

(iv) Calculate an upper bound for ψ(100) and an estimate of ψ1(100,1) .

(v) Comment on the results in (iv).

3. Individual claim amounts from a particular type of insurance policy follow a normal distribution with mean 150 and standard deviation 30. Claim numbers on an individual policy follow a Poisson distribution with parameter 0.25. The insurance company uses a premium loading of 70% to calculate premiums.

(i) Calculate the annual premium charged by the insurance company.

The insurance company has an individual excess of loss reinsurance arrangement with a retention of 200 with a reinsurer who uses a premium loading of 120%.

(ii) Calculate the probability that an individual claim does not exceed the retention.

(iii) Calculate the probability for a particular policy that in a given year there are no claims which exceed the retention.

(iv) Calculate the premium charged by the reinsurer.

(v) Calculate the insurance company's expected profit.

4. The following table shows the claim payments for an insurance company in units of £5,000:

	Development year			
Accident year	*0*	*1*	*2*	*3*
2004	410	814	216	79
2005	575	940	281	
2006	814	1066		
2007	1142			

The inflation for a 12 month period to the middle of each year is given as follows:

2005	*2006*	*2007*
5%	5.5%	5.4%

The future inflation from 2007 is estimated to be 8% per annum.
Claims are fully run-off at the end of the development year 3.

Calculate the amount of outstanding claims arising from accidents in year 2007, using the inflation adjusted chain ladder method.

5. The cumulative incurred claims for an insurance company for the last four accident years are given in the following table:

	Development year			
Accident year	*0*	*1*	*2*	*3*
2005	96	136	140	168
2006	100	156	160	
2007	120	130		
2008	136			

It can be assumed that claims are fully run off after three years. The premiums received for each year from 2005 to 2008 are 175, 181, 190 and 196 respectively.

Calculate the reserve at the end of year 2008 using:
(a) The basic chain ladder method.
(b) The Bornhuetter-Ferguson method.

6. An actuarial student has been working on some claims projections but some of her workings have been lost. The cumulative claim amounts and projected ultimate claims are given by the following table:

Accident Year	*Development Year* 0	1	2	3	*Ultimate*
1	1001	1485	1762	*W*	*X*
2	1250	*Y*	1820		1862.3
3	1302	1805			2122.5
4	*Z*				2278.8

All claims are paid by the end of development year 3.

It is known that ultimate claims for accident years 2 and 3 have been estimated using the Basic Chain Ladder method.

(i) Calculate the values of *W*, *X* and *Y*.

For accident year 4 the student has used the Bornhuetter-Ferguson method using an earned premium of 2,500 and an expected loss ratio of 90%.

(ii) Calculate the value of *Z*.

(iii) Calculate the outstanding claims reserve for all accident years implied by the completed table.

7. The table below shows the incremental claims incurred for a certain portfolio of insurance policies.

Accident year	*Development year* 0	1	2
2011	2,233	1,389	600
2012	3,380	1,808	
2013	4,996		

Cumulative numbers of claims are shown in the following table:

Accident year	*Development year*		
	0	*1*	*2*
2011	140	203	224
2012	180	230	
2013	256		

(i) Calculate the outstanding claim reserve for this portfolio using the average cost per claim method with grossing up factors.

(ii) State the assumptions underlying the calculations in part (i).

8. i) Claims occur on a portfolio of insurance policies according to a Poisson process at a Rate λ. All claims are for a fixed amount d, and premiums are received continuously. The insurer's initial surplus is U (< d) and the annual premium income is 1.2 λ d. Pick the probability that ruin occurs at the first claim is:

I. $1-e^{-1/1.2\ (1-U/d)}$
II. $1-e^{-1/1.2\ (1-U/d\lambda)}$
III. $1-e^{-1/1.2\ \lambda\ (1-U/d)}$
IV. $1-e^{-1/1.2\ d\ (1-U/d)}$

(ii) An insurer has issued five-year term assurance policies to two individuals involved in a dangerous sport. Premiums are payable annually in advance, and claims are paid at the end of the year of death.

Individual	Annual Premium (in Rs)	Sum Assured	Prob. of death (annual)
A	10000	17,00,000	0.05
B	5000	4,00,000	0.10

Assume that the probability of death is constant over each of the five years of the policy. Suppose that the insurer has an initial surplus of U.

a) Define what is meant by ψ(U) and ψ(U,t) .
b) Assuming U = 10,00,000, determine the distribution of S(1), the surplus at the end of the first year, and hence calculate ψ(U,1) .
c) Assuming U = 10,00,000, determine the possible values of S(2) and hence calculate ψ(U,2).

9. The claims paid on a Fire Insurance Portfolio are as follows:

			Rs. In Crores	
	Claims paid in the year of Development			
Year of Accident	**1**	**2**	**3**	**4**
2018	275	115	62	22
2019	315	162	82	
2020	180	170		
2021	450			

The claims are paid at the end of Development Year. Inflation rate for the past years and the expected inflation rates for the future years are as follows:

Year	2018	2019	2020	2021	2022	2023	2024
Inflation	4.00%	5.00%	3.00%	6.00%	7.00%	7.00%	10.00%

(i) Whether the Inflation figures for all the above years are useful in the calculation. If not, state with reason which year inflation has no relevance in the estimation.

(ii) Calculate the outstanding claim reserve at the end year 2021 using inflation adjusted Chain Ladder Method.

(iii) State any assumptions made to estimate the reserve underlying in the above Method.

Round all the figures except the development factors to nearest integer. Development factors round to 3 digits.

10. On 1 January 2016 an insurance company writes a Fasal Bima Yojana policy for the farmer. At the end of each year, the farmer's crop is assessed, and if it is less than 100 tonnes, it is deemed to have failed. If the crop fails for two years in a row the insurance policy pays out Rs. 10 Lakhs and then is immediately terminated. Premiums are Rs. 25000 per month, paid in advance, and there are no expenses. This is the only policy the insurance company writes, and it has initial surplus $U > 0$. Denote by $\Psi(U,t)$ the probability of ruin by time t, measured in years; and $\Psi(U)$ as the ultimate probability of ruin.

(i) Explain whether the following statements are TRUE or FALSE:

a) $\Psi(U,1) < \Psi(U,1.5)$
b) $\Psi(U,2.5) = \Psi(U,3.33)$
c) $\Psi(U,3) < \Psi(U,4)$
d) $\Psi(U,4) = \Psi(U)$

PV Sindhu is an Indian shuttler who will be competing at the Olympic Games. She has taken out special insurance which pays out if she is injured. If the injury is so serious that her career has ended, the policy will pay 10 Crores and will be terminated. If she is injured but recovers, the insurance payment will be Rs 1 Crore and the policy will continue.

Unit 3 & 4

ASSIGNMENT QUESTIONS

The insurance company's underwriters believe that the probability of an injury in any year is 0.2, and that the probability of more than one injury in a year can be ignored.

If Sindhu is injured, there is a 75% chance that she will recover. Annual premiums are paid in advance, and the insurance company pays claims at the end of the year. Assume that this is the only policy that the insurance company writes and that it has an initial surplus of Rs. 1 Crore.

(ii) Calculate the annual premium charged assuming the insurance company uses a premium loading of 30%. (2)

(iii) Determine $\psi(1\text{Crore}, 2)$