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Subject: SRM - 2

Chapter:

Category: Assignment Questions

1. Claims on a portfolio of insurance policies follow a Poisson process with parameter λ. The insurance company calculates premiums using a premium loading of θ and has an initial surplus of U.
(i) Define the surplus process $U(t)$. [1]

(ii) Define the probabilities $\psi(U, t)$ and $\psi(U)$. [2]

(iii) Explain how $\psi(U, t)$ and $\psi(U)$ depend on λ. [2]
[Total 5]

2. 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 $M_x(t)$. [3]

(ii) Determine the adjustment coefficient and hence derive an upper bound on the probability of ruin if the insurance company has initial surplus U. [5]

(iii) Find the surplus required to ensure the probability of ruin is less than 1% using the upper bound in (ii). [2]

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. [4]
[Total 14]

3. 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 $\psi(100)$, $\psi(100,1)$ and $\psi 1(100,1)$. [3]

(ii) Define the adjustment coefficient R. [1]

(iii) Show that for this portfolio the value of R is 0.011 correct to 3 decimal places. [5]

(iv) Calculate an upper bound for $\psi(100)$ and an estimate of $\psi 1(100,1)$. [5]

(v) Comment on the results in (iv). [2]
[Total 16]

SRM 2-UNIT 3 & 4

ASSIGNMENT QUESTIONS

4. 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. [1]

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. [2]

(iii) Calculate the probability for a particular policy that in a given year there are no claims which exceed the retention. [2]

(iv) Calculate the premium charged by the reinsurer. [4]

(v) Calculate the insurance company's expected profit. [2]
[Total 11]

5. On 1 January 2014 an insurance company wrote a policy for a European 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 €1m and then is immediately terminated.

Premiums are €25k 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.

Explain whether the following statements are TRUE or FALSE:

(a) $\Psi(U,1) < \Psi\left(U,1\frac{1}{2}\right)$

(b) $\Psi\left(U,2\frac{1}{2}\right) = \Psi\left(U,3\frac{1}{3}\right)$

(c) $\Psi(U,3) < \Psi(U,4)$

(d) $\Psi(U,4) = \Psi(U)$

6. 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.
[9]

7. 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.
[12]

8. 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*. [5]

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*. [4]

(iii) Calculate the outstanding claims reserve for all accident years implied by the completed table. [1]
[Total 10]

9. The following table shows incremental claims data from a portfolio of insurance policies for the accident years 2010, 2011 and 2012. Claims from this type of policy are fully run off after the end of development year two.

Incremental Claims		*Development year* 0	1	2
Accident year	2010	2,328	1,484	384
	2011	1,749	1,188	
	2012	2,117		

Estimate the total claims outstanding using the basic chain ladder technique. [7]

10. 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. [7]
(ii) State the assumptions underlying the calculations in part (i). [3] [Total 10]