

ACSC/STAT 3703, Actuarial Models I

WINTER 2024

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Homework Sheet 2

Due: Wednesday 31st January: 13:00

Note: This homework assignment is only valid for WINTER 2024. If you find this homework in a different term, please contact me to find the correct homework sheet.

Basic Questions

1. An insurer collects \$19,060,000 in earned premiums for accident year 2023. The total loss payments are \$15,329,000. Payments are subject to inflation of 4%, and policies are sold uniformly throughout the year. If the insurer's permissible loss ratio is 80%, by how much should the premium be changed for policy year 2026?
2. An insurer is reviewing claims for a certain line of insurance from Accident year 2023. The earned premiums in 2023 were \$7.7 million. The base premium in 2023 was \$1,120. However there was a rate change from the old premium of \$1,070 on 1st May 2023. The total losses in Accident Year 2023 were \$6.43 million. What should the new premium for Policy Year 2025 be if the permissible loss ratio is 0.75 and annual inflation is 7%?
[Assume policies are sold and losses occur uniformly through the year.]
3. An insurance company has two lines of coverage in its auto insurance packages, with different expected loss ratios, and has the following data on recent claims:

Policy Type	Policy Year	Earned Premiums	Expected Loss Ratio	Losses paid to date
Medical	2021	\$16,000,000	0.78	\$10,600,000
	2022	\$18,700,000	0.80	\$6,300,000
	2023	\$19,200,000	0.81	\$3,900,000
Property	2021	\$4,600,000	0.85	\$3,500,000
	2022	\$5,100,000	0.84	\$3,400,000
	2023	\$6,200,000	0.83	\$2,800,000

Calculate the loss reserves at the end of 2023.

4. The following table shows the cumulative paid losses (in thousands) on claims from one line of business of an insurance company over the past 5 years.

Accident year	Earned premiums	Development year				
		0	1	2	3	4
2019	37832	10873	16313	20489	23867	24452
2020	39619	8790	16279	23080	25669	
2021	44936	12498	20945	27821		
2022	47014	13098	21971			
2023	49669	11459				

Assume that all payments on claims arising from accidents in 2019 have now been settled. Estimate the future payments arising each year from open claims arising from accidents in each calendar year using

- The loss development triangle method
- The Bornhuetter-Ferguson method with expected loss ratio 0.81.

Standard Questions

- An insurance company starts a new line of insurance at the start of July 2021. It sells policies at a uniform rate throughout 2021, and for the first half of 2022. It then sells policies at a new rate that is 30% lower during the second half of 2022. It finds that by increasing its premium by 10%, it would have achieved the desired loss ratio for accident year 2022. The actuary estimates inflation is 5%. By how much should the premiums increase for policy year 2025, assuming policies are sold uniformly during 2024?
- An insurance company has the following cumulative aggregate loss development data:

Accident year	Development year				
	0	1	2	3	4
2019	2690	4084	8015	11636	15137
2020	3229	4359	8491	15104	
2021	3232	5514	8394		
2022	4026	6307			
2023	4095				

From this table, it calculates the following mean loss development factors:

Development year	LDF
0/1	1.537831
1/2	1.784051
2/3	1.620017
3/4	1.300877

and the following cumulative reserves:

Accident year	Development year				
	0	1	2	3	4
2020					19648.44
2021				13598.42	17689.87
2022			11252.010	18228.45	23712.96
2023		6297.418	11234.915	18200.75	23676.93

It is discovered that one claim payment was recorded in the wrong year, and the cumulative losses for 2020 development year 1 should have been 5621. All other values remain the same.

(a) By how much do the necessary reserves at the end of 2023 decrease? [These are the total reserves for all expected payments after 2023 from all accident years.]

(b)

The earned premiums in each year are given in the following table:

Year	Earned Premiums (000's)
2018	21,903
2019	22,743
2020	24,215
2021	24,886
2022	26,704

Using the Bornhuetter-Fergusson method with expected loss ratio 0.81, the reserves for each year are:

Accident year	Expected Claims	Development year				
		0	1	2	3	4
2020	18421.83					4260.740
2021	19614.15				5770.553	4536.509
2022	20157.66			4203.601	5930.455	4662.216
2023	21630.24		2012.036	4510.687	6363.693	5002.806

meaning that the total reserves are 47253.30. How much will the total reserves be changed if the cumulative losses for 2020, development year 1 are changed to 5621?