ACSC/STAT 3703, Actuarial Models I

WINTER 2025

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Homework Sheet 2

Due: Thursday 30th January: 14:30

Note: This homework assignment is only valid for WINTER 2025. If you find this homework in a different term, please contact me to find the correct homework sheet.

Basic Questions

1. An insurer collects \$16,400,000 in earned premiums for accident year 2024. The total loss payments are \$11,932,000. Payments are subject to inflation of 5%, and policies are sold uniformly throughout the year. If the insurer's permissible loss ratio is 75%, by how much should the premium be changed for policy year 2028?

2. An insurer is reviewing claims for a certain line of insurance from Accident Year 2024. The earned premiums in 2024 were \$11.2 million. The base premium in 2024 was \$930. However there was a rate change from the old premium of \$895 on 1st October 2023, which affects some policies in Accident Year 2024. The total losses in Accident Year 2024 were \$9.43 million. What should the new premium for Policy Year 2026 be if the permissible loss ratio is 0.8 and annual inflation is 6%?

   [Assume policies are sold and losses occur uniformly through the year.]

3. An insurance company has two lines of coverage in its tenant's 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
House	2022	\$14,400,000	0.77	\$9,300,000
	2023	\$15,000,000	0.75	\$8,400,000
	2024	\$15,700,000	0.76	\$7,700,000
Apartment	2022	\$15,400,000	0.81	\$12,100,000
	2023	\$14,900,000	0.82	\$11,600,000
	2024	\$16,300,000	0.82	\$10,900,000

   Calculate the loss reserves at the end of 2024.

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
2020	50889	7145	19180	33387	36966	39648
2021	57723	9705	23004	39189	42420	
2022	55395	8894	19217	37796		
2023	61480	9712	22537			
2024	58319	6665				

Assume that all payments on claims arising from accidents in 2020 have now been settled. Estimate the future payments arising each year from open claims arising from accidents in each calendar year using

(a) The loss development triangle method

(b) The Bornhuetter-Ferguson method with expected loss ratio 0.81.

Standard Questions

5. An insurance company starts a new line of insurance at the start of October 2022. It sells policies at a uniform rate throughout the remainder of 2022, and for the first two months of 2023. Because of technical difficulties, it cannot sell policies in March or April 2023. The policies that it would have sold in March and April are all sold on 1st May 2023. It then sells policies at the same uniform rate throughout the remainder of 2023.

   It finds that by increasing its premium by 8%, it would have achieved the desired loss ratio for accident year 2023. The actuary estimates inflation is 4%. By how much should the premiums increase for policy year 2025, assuming policies are sold uniformly during 2025?

6. An insurance company has the following cumulative aggregate loss development data:

Accident year	Earned Premium	Development year 0	1	2	3	4
2020	19291	4467	9866	14433	15351	15802
2021	23607	7331	12180	16834	17985	
2022	22464	7957	12041	15462		
2023	23343	5801	12259			
2024	19574	5340				

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

Development year	LDF
0/1	1.813508
1/2	1.370875
2/3	1.066172
3/4	1.029379

and the following cumulative reserves:

Accident	Development year					
year	0	1	2	3	4	
2021						18513
2022					16485	16969
2023				16806	17918	18444
2024			9684	13276	14154	14570

The total reserves at the end of 2024 are therefore

$$18513 - 17985 + 16969 - 15462 + 18444 - 12259 + 14570 - 5340 = 17450$$

After a correction to a payment made in Accident year 2020, Development year 3, the cumulative losses are increased by 2000 in Development years 3 and 4 for that accident year.

(a) By how much do the necessary reserves at the end of 2024 change?

(b)

Using the Bornhuetter-Fergusson method with expected loss ratio 0.81, the reserves before the correction were

Accident	Expected	Development year				
year	Claims	0	1	2	3	4
2021	19121.67					545.7457
2022	18195.84				1097.0937	519.3218
2023	18907.83			4660.884	1140.0222	539.6425
2024	15854.94		4727.227	3908.330	955.9523	452.5109

meaning that the total reserves are 18546.73. What will the new reserves be after the correction?