

# ACSC/STAT 3703, Actuarial Models I

WINTER 2023

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Homework Sheet 2

Due: Wednesday 1st February: 11:30

**Note: This homework assignment is only valid for WINTER 2023. If you find this homework in a different term, please contact me to find the correct homework sheet.**

## Basic Questions

1. An insurer collects \$9,360,000 in earned premiums for accident year 2022. The total loss payments are \$7,791,000. Payments are subject to inflation of 5%, 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 2024?
2. An insurer is reviewing claims for a certain line of insurance from Accident year 2022. The earned premiums in 2022 were \$5.9 million. The base premium in 2022 was \$730. However there was a rate change from the old premium of \$680 on 1st September 2021, and that old premium still applied to some policies in force in 2022. The total losses in Accident Year 2022 were \$5.14 million. What should the new premium for Policy Year 2024 be if the permissible loss ratio is 0.75 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 Fire 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
Fire	2020	\$13,800,000	0.76	\$7,700,000
	2021	\$14,400,000	0.75	\$4,600,000
	2022	\$15,500,000	0.76	\$2,500,000
Earthquake	2020	\$6,500,000	0.74	\$2,100,000
	2021	\$5,800,000	0.74	\$1,100,000
	2022	\$7,100,000	0.75	\$800,000

Calculate the loss reserves at the end of 2022.

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
2018	15371	2483	6837	10591	12728	13267
2019	14506	3038	8319	10009	10031	
2020	25385	5379	11893	14621		
2021	6468	1940	3339			
2022	22870	5146				

Assume that all payments on claims arising from accidents in 2018 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 using mean loss development factors  
 (b) The Bornhuetter-Ferguson method with expected loss ratio 0.77, using average loss development factors.

## Standard Questions

5. An insurance company is reviewing a line of insurance for accident year 2021. It finds that by increasing its premium by 8%, it would have achieved the desired loss ratio. The actuary estimates inflation will be 6%. Policies were sold uniformly during 2020, and were sold uniformly at a 40% higher rate in 2021 (that is, in any month of 2021, 1.4 times as many policies were sold as the same month in 2020). By how much should the premiums increase for policy year 2023, assuming policies are sold uniformly during 2023?
6. An insurance company has the following cumulative aggregate loss development data:

Accident year	Earned premiums	Development year				
		0	1	2	3	4
2018	21832	3908	7216	8596	14688	16939
2019	26322	5904	8011	12717	20535	
2020	16472	8002	11066	14044		
2021	27447	4315	11526			
2022	41419	8659				

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

Development year	LDF
0/1	1.709024
1/2	1.344731
2/3	1.652653
3/4	1.153254

and the following cumulative reserves:

Accident year	Development year				
	0	1	2	3	4
2019					23682.08
2020				23209.86	26766.88
2021			15499.36	25615.08	29540.70
2022	14798.44	19899.92	32887.66	37927.84	

An adjustment to a previously closed claim means that the cumulative losses for 2021, development year 1 should have been \$7,390.

(a) By how much the the necessary reserves at the end of 2022 decrease?  
[These are the total reserves for all expected payments after 2022 from all accident years.]

(b) 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
2019	21320.82					2833.294
2020	13342.32				4568.851	1773.042
2021	22232.07			2990.319	7612.996	2954.389
2022	33549.39	5430.695	4512.552	11488.420	4458.331	

How much will the total reserves be changed if the cumulative losses for 2021, development year 1 are changed to \$7,390.