

# ACSC/STAT 4703, Actuarial Models II

FALL 2024

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Homework Sheet 7

Due: Thursday 21st November: 11:30

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

## Basic Questions

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

| Accident<br>year | Earned<br>premiums | Development year |       |      |      |      |
|------------------|--------------------|------------------|-------|------|------|------|
|                  |                    | 0                | 1     | 2    | 3    | 4    |
| 2019             | 40961              | 6785             | 13970 | 6914 | 3422 | 1669 |
| 2020             | 37144              | 7941             | 9810  | 6287 | 6252 |      |
| 2021             | 41814              | 9894             | 13919 | 7782 |      |      |
| 2022             | 62205              | 9454             | 15881 |      |      |      |
| 2023             | 82847              | 11739            |       |      |      |      |

This table is in the file `HW7Q1.txt`

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

- (a) The chain-ladder method
  - (b) The Bornhuetter-Ferguson method with expected loss ratio 0.77.
  - (c) The Bühlmann-Straub estimate.
2. The file `HW7_Q2.txt` contains a run-off triangle. An actuary is planning to use the chain-ladder method to estimate future reserves. Test whether losses in different years are correlated, and whether there are any calendar year effects.
  3. For the run-off table in Question 1, use Mack's model to estimate the MSE of the estimated outstanding losses.
  4. The files `HW7Q4_reported.txt`, `HW7Q4_settled.txt` and `HW7Q4_aggregate.txt` give numbers of claims reported and settled, and aggregate claim amounts for each accident year and development year. By using the chain-ladder method to project number of reported claims, proportions of settled claims and average aggregate losses per claim, estimate the reserves needed.

## Standard Questions

5. An actuary is using a Poisson model to analyse the run-off triangle from Question 1.

- (a) Show that the following values of  $\gamma_j$  are within a 0.05 likelihood interval under the Poisson model. (That is, show that the likelihood for these parameter values is at least 0.05 times the maximum likelihood for the data.)

| $j$  | $\gamma_j$ |
|------|------------|
| 2019 | 0.235      |
| 2020 | 0.365      |
| 2021 | 0.20       |
| 2022 | 0.15       |
| 2023 | 0.05       |

- (b) For the values in the above table, what is the probability that outstanding claims exceed \$65,000,000?