ACSC/STAT 4703, Actuarial Models II

FALL 2024
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Homework Sheet 8

Due: Thursday 28th 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 file `HW8_data.txt` contains a run-off triangle. Fit an overdispersed Poisson model to this data and use it to find the 95th percentile of estimated outstanding claims.

   [The easiest way to do this is by simulation. The parameter estimates should be approximated by a multivariate normal distribution. You can use `vcov` to find the variance matrix of this distribution, and use the `mvrnorm` function in the `MASS` package to simulate the parameter estimates.]

2. A health insurance company classifies policyholders as "Young", "Middle-aged" and "Elderly. The experience from policy year 2023 is:

Policyholder	Current differential	Earned premiums (000s)	Loss payments (000s)
Young	0.47	9,600	8,040
Middle-aged	1	14,400	9,330
Elderly	1.82	11,700	8,720

   The base premium was $750. If the expense ratio is 25%, calculate the new premiums for each type of policyholder (ignoring inflation) for policy year 2025.

3. An insurer uses two variables to classify companies. The categories and differentials are given in the following table:

Size Category		Industry	
Small (1–30 employees)	0.89	Manufacture	1.85
Medium (31-100 employees)	1	Resources	2.21
Large (> 100 employees)	1.30	Services	1

   The earned premiums from accident year 2023 are:

| | Industry | | | |
Size Category	Manufacture	Resources	Services	Total
Small	4,201	3,521	9,105	16,827
Medium	7,367	8,202	12,494	28,063
Large	9,242	7,339	7,322	23,903
Total	20,810	19,062	28,921	68,793

And the claims are:

Category	Total Claims
Small	12,593
Medium	23,312
Large	19,690
Manufacture	15,379
Resources	16,022
Services	24,104
Total	55,505

The expense ratio is 0.2. Ignoring inflation, by what factor should they increase the base premium in future years?

Standard Questions

4. An insurance company uses three variables: sex, age category and vehicle type to distinguish policyholders. The base classes are "Female", "Young" and "Car". The total losses from policy year 2023 were $5,305,444.

The total earned premiums for each combination of age category and vehicle type were as given in the following table:

	Car	Motorcycle	Total
Young	2,895,987	675,686	3,571,673
Elderly	2,557,859	249,931	2,807,790
Total	5,453,846	925,617	6,379,463

The total earned premiums for each combination of age category and sex were as given in the following table:

	Female	Male	Total
Young	1,750,810	1,820,863	3,571,673
Elderly	1,548,972	1,258,818	2,807,790
Total	3,299,782	3,079,681	6,379,463

The total earned premiums for each combination of vehicle type and sex were as given in the following table:

	Car	Motorcycle	Total
Female	2,978,702	321,080	3,299,782
Male	2,475,144	604,537	3,079,681
Total	5,453,846	925,617	6,379,463 6,119,219

After reviewing the data for 2023, they calculate the following new differentials:

Class	Old differential	New differential
Male	1.201	1.323
Elderly	1.103	1.053
Motorcycle	0.536	0.564

With an expense ratio of 0.2, The base premium is adjusted by a factor 1.003274. What were the total earned premiums from elderly female motorcyclists?