ACSC/STAT 4703, Actuarial Models II

FALL 2021
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Homework Sheet 5

Due: Thursday 18th November: 11:30 AM

Basic Questions

1. An insurance company sets the book pure premium for its liability insurance at \$5,410. The expected process variance is 5,859,000 and the variance of hypothetical means is 1,310,600. If a company has aggregate claims of \$12,500 over the past 9 years, calculate the credibility premium for this company's next year's insurance using the Bühlmann model.

2. An insurance company has the following data on a workers' compensation insurance policy for a company.

Year	1	2	3	4	5
Exposure	4,392	5,045	4,803	5,107	5,246
Aggregate claims	\$423,100	\$0	\$746,400	\$1,062,700	\$547,300

   The book premium is \$494 per unit of exposure. The variance of hypothetical means per unit of exposure is 351,326. The expected process variance per unit of exposure is 7,926,306,225. Using a Bühlmann-Straub model, calculate the credibility premium for Year 6 if the company has 5,475 units of exposure.

3. An insurance company has the following previous data on aggregate claims:

Policyholder	Year 1	Year 2	Year 3	Year 4	Year 5	Mean	Variance
1	1318.14	4535.25	1484.57	0.00	4783.58	2424.308	4501556.23227
2	344.07	0.00	0.00	662.08	0.00	201.230	88566.63170
3	0.00	0.00	0.00	21.49	0.00	4.298	92.36402
4	1051.40	0.00	392.33	0.00	0.00	288.746	210623.38158
5	0.00	348.42	0.00	568.79	0.00	183.442	69165.93092

   Calculate the Bühlmann credibility premium for each policyholder in Year 6.

Standard Questions

4. A workers' compensation insurance company models the number of claims made by a company in a year as a Poisson distribution with mean proportional to their exposure multiplied by a constant that varies between companies. It has the following data from 2020:

Exposure	No. of Claims	Exposure	No. of Claims	Exposure	No. of Claims
1424	102	516	0	344	28
997	3	511	1	299	34
809	50	461	17	298	0
593	0	425	0	292	22
589	0	403	41	246	2
573	0	393	0	233	0
525	20	381	18	178	0

Using this data, calculate the credibility estimate for the expected claim frequency in the following year, for the first company, which made 102 claims from 1424 units of exposure, if that company has 1,330 units of exposure the following year.

5. Aggregate claims for a given individual policy are modelled as following an inverse gamma distribution with $\alpha = 5$ and θ varying between individuals. The first 5 years of experience on this policy are:

Policyholder	Year 1	Year 2	Year 3	Year 4	Year 5	Mean	Variance
1	87.11	80.68	0.00	43.41	0.00	42.240	1765.18865
2	15.06	0.00	0.00	0.00	0.00	3.012	45.36072
3	79.61	231.22	140.19	0.00	0.00	90.204	9692.46713
4	0.00	23.44	22.07	51.07	165.67	52.450	4334.04995

(a) Estimate the EPV and VHM.

(b) Calculate the credibility premium for Policyholder 3 in the next year.