ACSC/STAT 4703, Actuarial Models II

FALL 2022

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Homework Sheet 5

Due: Thursday 17th November: 17:30

Basic Questions

1. An insurance company sets the book pure premium for its group health insurance at \$730. The expected process variance is 9,224,000 and the variance of hypothetical means is 433,000. If a company has aggregate claims of \$54,200 over the past 13 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 commercial auto insurance policy for a company.

Year	1	2	3	4	5
Exposure	4,043	4,626	4,595	4,906	5,304
Aggregate claims	\$894,100	\$1,305,500	\$991,400	\$1,126,700	\$1,295,000

The book premium is \$602 per unit of exposure. The variance of hypothetical means per unit of exposure is 92,682. The expected process variance per unit of exposure is 8,046,942,802. Using a Bühlmann-Straub model, calculate the credibility premium for Year 6 if the company has 6,014 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	0.00	0.00	0.00	0.00	0.00	0.000	0.00000
2	443.61	0.00	0.00	0.00	0.00	88.722	39357.96642
3	657.96	0.00	0.00	1299.19	0.00	391.430	338679.69830
4	0.00	0.00	0.00	0.00	1990.59	398.118	792489.70962
5	0.00	2573.86	48153.45	0.00	0.00	10145.462	452681876.55872

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

Standard Questions

4. A 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:

Policyholder	Exposure	No. of Claims	Policyholder	Exposure	No. of Claims	Policyholder	Exposure	No. of Claims
1	2005	2	9	586	50	17	319	16
2	1273	0	10	535	13	18	223	2
3	1135	15	11	509	28	19	220	22
4	973	0	12	504	1	20	220	0
5	861	2	13	496	18	21	189	2
6	826	0	14	458	44	22	188	3
7	662	33	15	401	0	23	181	0
8	619	0	16	394	12	24	147	15

Using this data, calculate the credibility estimate for the expected claim frequency in the following year, for policyholder 3, who made 15 claims from 1135 units of exposure, if that policyholder has 1,310 units of exposure the following year.

5. Aggregate claims for a given individual policy are modelled as following a Pareto distribution with $\alpha = 3$ 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	663.93	1018.96	588.18	768.51	600.04	727.924	31581.77793
2	622.80	723.56	637.23	843.72	743.15	714.092	7994.85627
3	11.81	14.33	12.13	15.87	13.40	13.508	2.76212
4	1625.20	2125.83	2325.31	1592.02	3829.92	2299.656	832055.28003
5	140.58	142.46	138.79	330.92	273.83	205.316	8259.46703

(a) Estimate the EPV and VHM.

(b) Calculate the credibility premium for Policyholder 5 in the next year.