

# ACSC/STAT 4703, Actuarial Models II

Fall 2020

Toby Kenney

Homework Sheet 4

Due: Friday 13th March: 13:30 PM

## Basic Questions

1. An insurance company sells insurance. It estimates that the standard deviation of the aggregate annual claim is \$4,521 and the mean is \$1,020.

(a) How many years history are needed for an individual or group to be assigned full credibility? (Use  $r = 0.05$ ,  $p = 0.90$ .)

The standard premium for this policy is \$1,020. A company has claimed a total of \$8,072 in the last 23 years.

(b) What is the Credibility premium for this company, using limited fluctuation credibility?

2. A home insurance company classifies houses as high, medium or low risk. Annual claims from high risk houses follow a Gamma distribution with  $\alpha = 4$  and  $\theta = 5000$ . Annual claims from medium risk houses follow a Gamma distribution with  $\alpha = 8$  and  $\theta = 1400$ . Annual claims from low risk houses follow a Gamma with  $\alpha = 14$  and  $\theta = 600$ . 15% of houses are high risk, 65% are medium risk and 20% are low risk.

(a) Calculate the expectation and variance of the aggregate annual claims from a randomly chosen home.

(b) Given that a homeowner's annual claims over the past 4 years are \$4,000, \$250 and \$1,100, what are the expectation and variance of the homeowner's claims next year?

## Standard Questions

3. For a certain insurance policy, the book premium is based on average claim frequency of 4.9 claims per year, and average claim severity of \$4,200. The standard for full credibility is 50 policy years for claim frequency and 230 claims for severity. The insurance company wants to change the standard for full credibility to a single standard (in terms of policy years) for aggregate claims. A particular group has 100 claims for a total of \$282,000, in 27 policy years of history. The insurance company wants the new standard to give the same premium for this group. What should the new standard be?

4. Aggregate claims for an individual are believed to follow a gamma distribution with  $\alpha = 0.8$  and  $\Theta$  varying between individuals. For a randomly chosen individual,  $\Theta$  follows an inverse gamma distribution with  $\alpha = 3$  and  $\theta = 2000$ . The insurance company uses limited fluctuation credibility with  $r = 0.05$  and  $p = 0.95$  to determine an individual's premium. If an individual has 6 years of past history, for what value of total claims during these 6 years would the limited fluctuation credibility premium equal the fair premium (using the Bayesian method)?
5. An insurance company has 4 years of past history on a marine insurance policy, denoted  $X_1, X_2, X_3, X_4$ . It uses a formula  $\hat{X}_5 = \alpha_0 + \alpha_1 X_1 + \alpha_2 X_2 + \alpha_3 X_3 + \alpha_4 X_4$  to calculate the credibility premium in the fifth year. It has the following information on the policy:
- In Year 1, the expected aggregate claim was \$32,000.
  - Expected aggregate claims increase by 4% per year.
  - The coefficient of variation of the aggregate claims is 0.8 in every year.
  - The correlation (recall  $\text{Corr}(X, Y) = \frac{\text{Cov}(X, Y)}{\sqrt{\text{Var}(X)\text{Var}(Y)}}$ ) between aggregate claims in years  $i$  and  $j$  is  $e^{-\frac{|i-j|}{2}}$  for all  $i \neq j$ .

Find a set of equations which can determine the values of  $\alpha_0, \alpha_1, \alpha_2, \alpha_3$  and  $\alpha_4$ . [You do not need to solve these equations.]