INSTITUTE OF ACTUARIAL & QUANTITATIVE STUDIES

Class: SY BSc

Subject : Statistical & Risk Modelling - 2

Chapter: Unit 1 Chapter 3

Chapter Name: Reinsurance

Agenda

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1.1 Reinsurance

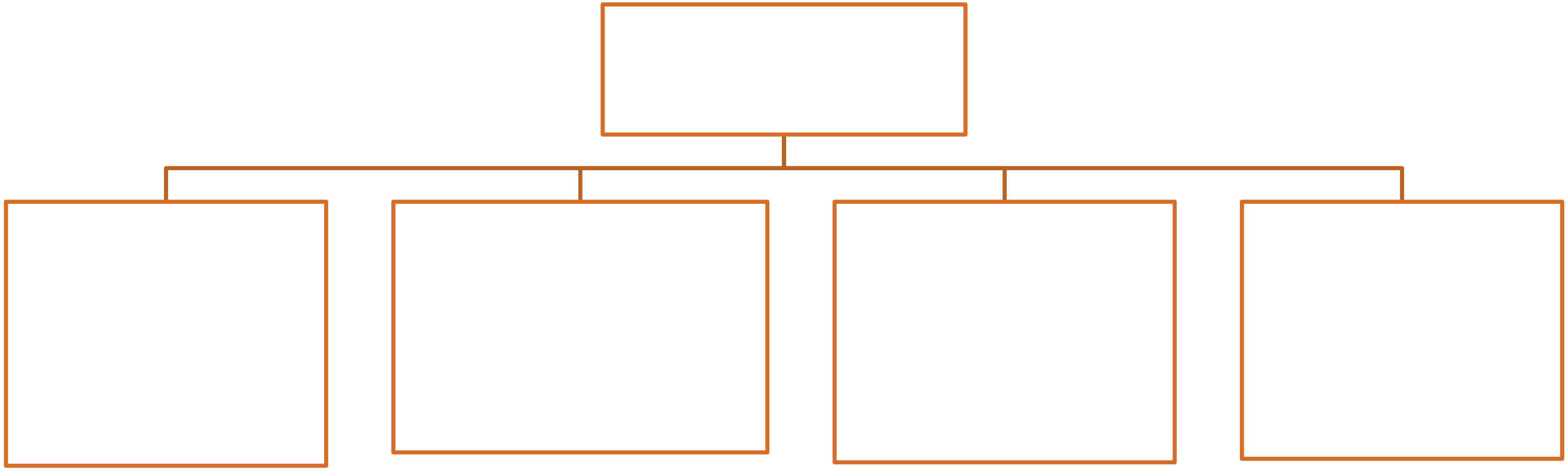
What is Reinsurance?

Reinsurance, often referred to as insurance for insurance companies, is a contract between a reinsurer and an insurer. In this contract, the insurance company—known as the ceding party or cedent—transfers some of its insured risk to the reinsurance company. The reinsurance company then assumes all or part of one or more insurance policies issued by the ceding party.

1.2 Reinsurance

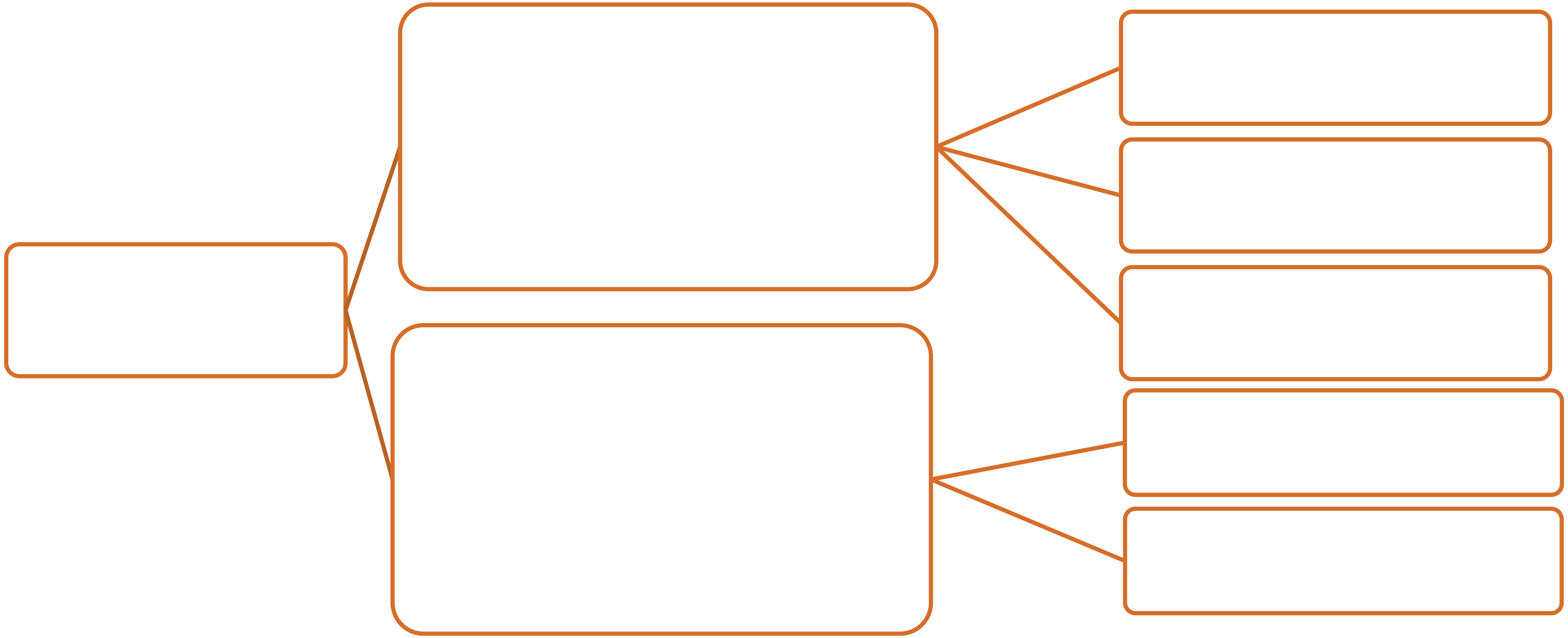
Why Reinsurance?

Insurers purchase reinsurance for four reasons: To limit liability on a specific risk, to stabilize loss experience, to protect themselves and the insured against catastrophes, and to increase their capacity.



1.3 Reinsurance

Types of Reinsurance?

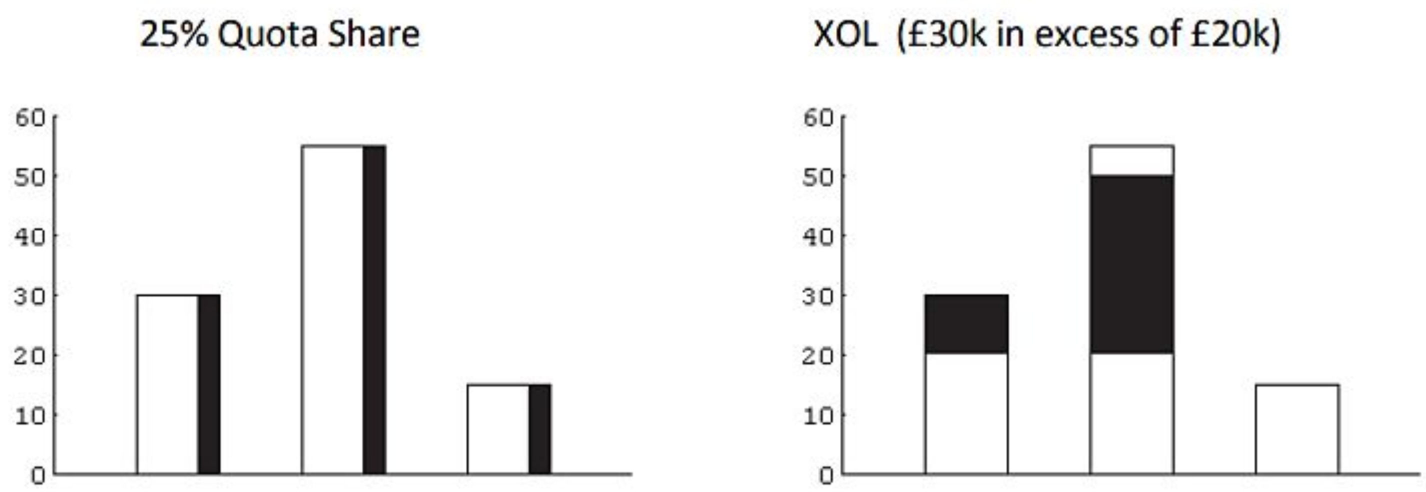


1.3 Reinsurance

Example

The diagram below shows how much the insurer and the reinsurer would pay when there are claims for £30,000, £55,000 and £15,000:
(a) under a 25% quota share arrangement, and
(b) under an individual XOL arrangement with a reinsurance layer of £30,000 in excess of £20,000.

The parts of each claim paid by the reinsurer are shown in black.



1.3 Reinsurance

Reinsurance arrangements and Notations

- The actual amount that the direct insurer ends up paying after allowing for payments under the reinsurance arrangements is called the net claim amount.
- The actual premium that the direct writer/insurer gets to keep after making any payments for reinsurance is the insurer's net premium income.
- The original amounts without adjustment for reinsurance are referred to as the gross claim amount and the insurer's gross premium income.

In this chapter we will use the following notation.

- **X** is the gross claim amount random variable

- **Y** is the net claim amount, ie the amount of the claim paid by the insurer in respect of a single claim (after receiving the reinsurance recovery)

- **Z** is the amount paid by the reinsurer in respect of a single claim.

1.3 Reinsurance

Example

For example, suppose that a reinsurer has agreed to make the following payments in respect of individual claims incurred by a direct insurer:

- nothing, if the claim is less than £5,000
- the full amount reduced by £5,000, if the claim is between £5,000 and £10,000
- half the full amount, if the claim is between £10,000 and £20,000

Then:

$$Z = \begin{cases} 0 & \text{if } X \leq £5{,}000 \\ X - 5{,}000 & \text{if } £5{,}000 < X \leq £10{,}000 \\ X/2 & \text{if } £10{,}000 < X \leq £20{,}000 \\ 10{,}000 & \text{if } X > £20{,}000 \end{cases} \quad \text{and} \quad Y = \begin{cases} X & \text{if } X \leq £5{,}000 \\ 5{,}000 & \text{if } £5{,}000 < X \leq £10{,}000 \\ X/2 & \text{if } £10{,}000 < X \leq £20{,}000 \\ X - 10{,}000 & \text{if } X > £20{,}000 \end{cases}$$

Note that $Y + Z = X$.

2 Excess of Loss Reinsurance

In excess of loss reinsurance, the insurer will pay any claim in full up to an amount $\boldsymbol{M}$, the retention level; any amount above $\boldsymbol{M}$ will be borne by the reinsurer.

Insurer's Payout

The excess of loss reinsurance arrangement can be written in the following way: if the claim is for amount X, then the insurer will pay Y where:

$$Y = \begin{cases} \mathbf{X} & \text{if } \mathbf{X} \leq \mathbf{M} \\ \mathbf{M} & \text{if } \mathbf{X} > \mathbf{M} \end{cases}$$

Reinsurer's Payout

Under excess of loss reinsurance, the reinsurer will pay Z where:

$$\boldsymbol{Z} = \begin{cases} \mathbf{0} & \textbf{if } \mathbf{X} \leq \boldsymbol{M} \\ \boldsymbol{X} - \boldsymbol{M} & \textbf{if } \boldsymbol{X} > \boldsymbol{M} \end{cases}$$

2 Excess of Loss Reinsurance

The insurer’s liability is affected in two obvious ways by reinsurance:

(i) the mean amount paid is reduced;

(ii) the variance of the amount paid is reduced.

Both these conclusions are simple consequences of the fact that excess of loss reinsurance puts an upper limit on large claims.

2 Excess of Loss Reinsurance

The mean amounts paid by the insurer and the reinsurer under excess of loss reinsurance can now be obtained. Observe that the mean amount paid by the insurer without reinsurance is:

$$E(X) = \int_0^\infty x f(x) dx$$

where $f(x)$ is the PDF of the claim amount $\boldsymbol{X}$.
With a retention level of $\boldsymbol{M}$ the mean amount paid by the insurer becomes:

$$\boldsymbol{E(Y) = \int_0^M x f(x) dx + MP(X > M)}$$

$\mathrm{var}(Y) = E(Y^2) - [E(Y)]^2.$

The mean amount paid by the reinsurer is:

$$\boldsymbol{E(Z) = \int_M^\infty (x - M) f(x) dx}$$

$\mathrm{var}(Z) = E(Z^2) - [E(Z)]^2$

3 Reinsurer’s Conditional Claim Distribution

Now consider reinsurance (once again) from the point of view of the reinsurer. The reinsurer may have a record only of claims that are greater than M . If a claim is for less than M the reinsurer may not even know a claim has occurred. The reinsurer thus has the problem of estimating the underlying claims distribution when only those claims greater than M are observed. **The statistical terminology is to say that the reinsurer observes claims from a truncated distribution.**

In this case the values observed by the reinsurer relate to a conditional distribution, since the numbers are conditional on the original claim amount exceeding the retention limit.

Let W be the random variable with this truncated distribution. Then:

$$\boldsymbol{W = X - M \mid X > M}$$

This can also be expressed as follows:

$$\boldsymbol{w = z \mid z > 0}$$

3 Reinsurer's Conditional Claim Distribution

Suppose that the underlying claim amounts have PDF $f(x)$ and CDF $F(x)$. Suppose that the reinsurer is only informed of claims greater than the retention M and has a record of $\boldsymbol{w = x - M}$. What is the PDF $\boldsymbol{g(w)}$ of the amount, $\boldsymbol{w}$, paid by the reinsurer?

The argument goes as follows:

$$
\begin{aligned}
P(W < w) &= P(X < w + M \mid X > M) \\
&= \frac{P(X < w + M \text{ and } X > M)}{P(X > M)} \\
&= \frac{P(M < X < w + M)}{P(X > M)} \\
&= \int_M^{w+M} \frac{f(x)}{1 - F(M)} dx \\
&= \frac{F(w + M) - F(M)}{1 - F(M)}
\end{aligned}
$$

Differentiating with respect to w, the PDF of the reinsurer's claims is:

$$\boldsymbol{g(w) = \frac{f(w+M)}{1 - F(M)}, w > 0}$$

3 Reinsurer's Conditional Claim Distribution

We can now calculate the expected value of W. Using the PDF of $W = X - M \mid X > M$, we have:

$$E(W) = \int_0^\infty w f_W(w)dw = \frac{\int_0^\infty w f_X(w+M)dw}{1 - F_X(M)} = \frac{\int_M^\infty (x-M)f_X(x)dx}{1 - F_X(M)} = \frac{E(Z)}{P(X > M)} = \frac{E(Z)}{P(Z > 0)}$$

3 Insurer's Conditional Claim Distribution

When there is excess of loss (XOL) reinsurance in picture, the insurer had a censored distribution.

The likelihood function is made up of two parts. If the values of $x_1, x_2, \ldots, x_n$ are recorded exactly these contribute a factor of:

$$L_1(\underline{\theta}) = \prod_{i=1}^{n} f(x_i; \underline{\theta})$$

If a further $\boldsymbol{m}$ claims are referred to the reinsurer, then the insurer records a payment of $\boldsymbol{M}$ for each of these claims. These censored values then contribute a factor:

$$L_2(\underline{\theta}) = \prod_{j=1}^{m} P(X > M) \text{ ie } [P(X > M)]^m$$

The complete likelihood function is:

$$\boldsymbol{L(\underline{\theta}) = \prod_{i=1}^{n} f(x_i; \underline{\theta}) \times [1 - F(M; \underline{\theta})]^m}$$

where $F(.; \underline{\theta})$ is the CDF of the claims distribution.

Question

CT6 September 2018 Q4

An insurance company has a portfolio of policies, where claim amounts follow a Pareto distribution with parameters $\alpha = 3$ and $\lambda = 100$. The insurance company has entered into an excess of loss reinsurance agreement with a retention of M, such that 90% of claims are still paid in full by the insurer.

(i) Calculate M. [4]

(ii) Calculate the average claim amount paid by the reinsurer, on claims which involve the reinsurer. [6]
[Total 10]

Solution

(i) $P(X < M) = 1 - \left(\dfrac{100}{100+M}\right)^3 = 0.9$ [1½]

$\left(\dfrac{100}{100+M}\right) = 0.1^{1/3} \Rightarrow M = \dfrac{100 - 100 * 0.1^{1/3}}{0.1^{1/3}} = 115.4$ [2½]

Solution

(ii) Let Y be the claim amount paid by the reinsurer, so that

$$Y = \begin{cases} 0 & X <= M \\ X - M & X > M \end{cases}$$

$$E(Y \mid X > M) = \frac{E(Z)}{P(X > M)}$$ [1]

$$E(Z) = \int_M^\infty (x - M) f(x) dx = \int_M^\infty (x - M) \frac{3 * 100^3}{(100 + x)^4} dx$$ [1]

$$u = (x - M); \frac{dv}{dx} = \frac{3 * 100^3}{(100 + x)^4}$$ [1]

Solution

Contd.

$$E(Z) = \left[-(x-M)\frac{100^3}{(100+x)^3} \right]_M^\infty + \int_M^\infty \frac{100^3}{(100+x)^3} dx \qquad [1]$$

$$= 0 + \left[\frac{-100^3}{2(100+x)^2} \right]_M^\infty = \left(\frac{100^3}{2(100+M)^2} \right) = 10.772 \qquad [1]$$

$$E(Y \mid X > M) = \frac{10.772}{0.1} = 107.7 \qquad [1]$$

[Total 10]

Question

CT6 April 2012 Q3

Claim amounts on a certain type of insurance policy follow a distribution with density

$$f(x) = 3cx^2 e^{-cx^3} \text{ for } x > 0$$

where c is an unknown positive constant.

The insurer has in place individual excess of loss reinsurance with an excess of 50.

The following ten payments are made by the insurer:

- Losses below the retention: 23, 37, 41, 11, 19, 33
- Losses above the retention: 50, 50, 50, 50

Calculate the maximum likelihood estimate of c. [6]

Solution

The likelihood function is given by:

$$L = D \times \prod_{i=1}^{6} 3cx_i^{\,2} e^{-cx_i^{\,3}} \times e^{-4\times 50^3 c}$$

where D is a constant.

Where the x_i are the claims below the retention.

$$l = \log L = \log D + \sum_{i=1}^{6} log\,3cx_i^{\,2} - c\sum_{i=1}^{6} x_i^{\,3} - 4\times 50^3 c$$

$$= \log D + 6\log 3 + 6\log c + \sum_{i=1}^{6} \log x_i^{\,2} - c\sum_{i=1}^{6} x_i^{\,3} - 4\times 50^3 c$$

Differentiating we get

$$\frac{dl}{dc} = \frac{6}{c} - \sum_{i=1}^{6} x_i^{\,3} - 500000$$

Solution

So our estimate is given by

$$\hat{c} = \frac{6}{\sum_{i=1}^{6} x_1^{\,3} + 500000} = \frac{6}{175868 + 500000} = 8.8775 \times 10^{-6}$$

4 Proportional Reinsurance

In proportional reinsurance the insurer pays a fixed proportion of the claim, whatever the size of the claim.

Using the same notation as above, the proportional reinsurance arrangement can be written as follows: if the claim is for an amount $\boldsymbol{X}$ then the company will pay Y where:

$$\boldsymbol{Y = \alpha X \qquad 0 < \alpha < 1}$$

The parameter $\boldsymbol{\alpha}$ is known as the retained proportion or retention level; note that the term retention level is used in both excess of loss and proportional reinsurance though it means different things.

Since $Y + Z = X$, we must have

$$\boldsymbol{Z = (1 - \alpha)X.}$$

The mean and variance of Y and Z are calculated as follows:

$$\boldsymbol{E(Y) = \alpha E(X) \qquad E(Z) = (1 - \alpha)E(X)}$$
$$\boldsymbol{\mathrm{var}(Y) = \alpha^2 \mathrm{var}(X) \quad \mathrm{var}(Z) = (1 - \alpha)^2 \mathrm{var}(X)}$$

5.1 Normal Distribution

There are useful integral formulae that simplify reinsurance calculations when working with normal and lognormal distributions.

Normal distribution

Truncated mean of the normal distribution
If $X \sim N(\mu, \sigma^2)$, then:

$$\int_{L}^{U} x f_X(x) dx = \mu[\Phi(U') - \Phi(L')] - \sigma[\phi(U') - \phi(L')]$$

where:

$$L' = \frac{L - \mu}{\sigma}$$
$$U' = \frac{U - \mu}{\sigma}$$

$\phi(z)$ is the PDF of the standard normal distribution
$\Phi(z)$ is the CDF of the standard normal distribution.

5.2 Lognormal Distribution

Lognormal distribution

Truncated moments of the lognormal distribution
If $X \sim \log N(\mu, \sigma^2)$, then:

$$\int_{L}^{U} x^k f_X(x) dx = e^{k\mu + 1/2 k^2 \sigma^2} [\Phi(U_k) - \Phi(L_k)]$$

where:

$$L_k = \frac{\ln L - \mu}{\sigma} - k\sigma$$
$$U_k = \frac{\ln U - \mu}{\sigma} - k\sigma$$

$\Phi(z)$ is the CDF of the standard normal distribution.

6 Inflation

The examples we have considered so far have assumed that claim distributions don't change over time

In practice claims are likely to increase because of inflation, at least in the longer term. A claim distribution that is suitable for modelling claim amounts in one year may well not be suitable a year or two later. We need to adjust our claim distributions to allow for inflation.

In this section we will look at how claims inflation affects reinsurance arrangements. It is easy to deal with claims inflation in the proportional reinsurance situation. The excess of loss reinsurance can cause a problem.

6 Inflation

With excess of loss reinsurance, inflation can cause a problem. Suppose that the claims $\boldsymbol{X}$ are inflated by a factor of $\boldsymbol{k}$ but the retention $\boldsymbol{M}$ remains fixed. What effect does this have on the arrangement?

The amount claimed is $\boldsymbol{kX}$, and the amount paid by the insurer, $\boldsymbol{Y}$, is:

$$\begin{aligned} Y &= kX \quad \text{if } kX \leq M \\ Y &= M \quad \text{if } kX > M \end{aligned}$$

The mean amount paid by the insurer is:

$$E(Y) = \int_0^{M/k} kxf(x)dx + MP(X > M/k)$$

The amount paid by the reinsurer is:

$$Z = \begin{cases} 0 & \text{if } X \leq \dfrac{M}{k} \\ kX - M & \text{if } X > \dfrac{M}{k} \end{cases}$$

7 Aggregate claim distributions

We introduced the notation S to denote the aggregate claim amount random variable, ie:

$$S = X_1 + X_2 + \cdots + X_N$$

where N denotes the number of claims and X_i denotes the amount of the i th claim.

Here we extend this concept to consider the situation when reinsurance is in force. We will use the following notation:

- Y_i is the amount paid by the insurer in respect of the i th claim
- z_i is the amount paid by the reinsurer in respect of the i th claim
- $S_I = Y_1 + Y_2 + \cdots + Y_N$ is the aggregate claim amount paid by the insurer
- $S_R = Z_1 + z_2 + \cdots + Z_N$ is the aggregate claim amount paid by the reinsurer.

The formulae that we derived for the mean, variance and MGF of S can be adapted to cover the reinsurance situation by replacing X by Y or Z, as appropriate.

7 Aggregate claim distributions

Proportional reinsurance

The distribution of the number of claims involving the reinsurer is the same as the distribution of the number of claims involving the insurer, as each pays a defined proportion of every claim.

For a retention level $\alpha(0 \leq \alpha \leq 1)$, the i th individual claim amount for the insurer is αX_i and for the reinsurer is $(1-\alpha)X_i$.

In other words:

$$\boldsymbol{Y_i = \alpha X_i}$$
$$\boldsymbol{Z_i = (1-\alpha) X_i}$$

ie the aggregate claims amounts are αS and $(1-\alpha)S$ respectively.

7 Aggregate claim distributions

Excess of Loss reinsurance

The amount that an insurer pays on the i th claim under individual excess of loss reinsurance with retention level M is $\boldsymbol{Y_i = \min\{X_i, M\}}$.

The amount that the reinsurer pays is $\boldsymbol{Z_i = \max\{0, X_i - M\}}$.

The insurer's aggregate claims net of reinsurance can be represented as:

$$\boldsymbol{S_I = Y_1 + Y_2 + \cdots + Y_N}$$

and the reinsurer's aggregate claims as:

$$\boldsymbol{S_R = Z_1 + Z_2 + \cdots + Z_N}$$

Question

CT6 April 2011 Q4

The number of claims on a portfolio of insurance policies has a Poisson distribution with mean 200. Individual claim amounts are exponentially distributed with mean 40. The insurance company calculates premiums using a premium loading of 40% and is considering entering into one of the following re-insurance arrangements:

(A) No reinsurance.

(B) (B) Individual excess of loss insurance with retention 60 with a reinsurance company that calculates premiums using a premium loading of 55%.

(C) Proportional reinsurance with retention 75% with a reinsurance company that calculates premiums using a premium loading of 45%.

(i) Find the insurance company's expected profit under each arrangement. [6]

(ii) Find the probability that the insurer makes a profit of less than 2000 under each of the arrangements using a normal approximation. [8]

[Total 14]

Solution

(i) Denote the insurers profits by Z

Under A:

Premium income = $200 \times 40 \times 1.4 = 11200$

Expected claims = $200 \times 40 = 8000$

So $E(Z) = 11200 - 8000 = 3200$

Under B

We need first to calculate the expected loss for the insurer. Denote the insurer's loss by X. Then

$$E(X) = \int_0^{60} 0.025xe^{-0.025x}dx + 60 \times \int_{60}^{\infty} 0.025e^{-0.025x}dx$$

$$= [-xe^{-0.025x}]_0^{60} + \int_0^{60} e^{-0.025x}dx + 60 \times [-e^{-0.025x}]_{60}^{\infty}$$

$$= -60e^{-1.5} + [-40e^{-0.025x}]_0^{60} + 60e^{-1.5}$$

$$= 40 - 40e{-1.5} = 31.07479359$$

So the expected loss for the re-insurer is $40 - 31.07479359 = 8.925206406$

Premium income = $11200 - 200 \times 1.55 \times 8.925206406 = 8433.186014$

Expected claims = $200 \times 31.07479359 = 6214.958718$

So $E(Z) = 8433.186014 - 6214.958718 = 2218.227$

Solution

<u>Under C</u>

Premium income $= 200 \times 40 \times 1.4 - 200 \times 40 \times 0.25 \times 1.45 = 8300$

Expected claims $= 200 \times 40 \times 0.75 = 6000$

So $E(Z) = 8300 - 6000 = 2300$

Solution

(ii) We now need to find the variance of the total claim amount paid by the insurer. Denote this by Y. Then

<u>Under A</u>

$$\text{Var}(Y) = 200\text{Var}(X) + 200E(X)2$$

$$= 200 \times 402 + 200 \times 402 = 640{,}000 = 8002$$

So

$$\Pr(Z < 2000) = \Pr(Y > 9200) = \Pr\left(N(0,1) > \frac{9200-8000}{800}\right)$$

$$= \Pr(N(0,1) > 1.5) = (1 - 0.93319) = 0.06681$$

Solution

Under B

We first need to find $E(X2)$ as defined above.

$$E(X2) = \int_0^{60} 0.025x^2 e^{-0.025x} dx + 60^2 \int_{60}^{\infty} 0.025 e^{-0.025x} dx$$

$$= [-x^2 e^{-0.025x}]_0^{60} + \int_0^{60} 2xe^{-0.025x} dx + 3600e^{-1.5}$$

$$= -3600e^{-1.5} + \frac{2}{0.025} \int_0^{60} 0.025xe^{-0.025x} dx + 3600e^{-1.5}$$

$$= \frac{2}{0.025}(E(X) - 60e^{-1.5}) = 1414.958718$$

Solution

And so

$$\text{Var}(X) = 1414.958718 - 31.07479359^2 = 449.3159219$$

And therefore

$$\text{Var}(Y) = 200\text{Var}(X) + 200E(X)2$$

$$= 200 \times 449.3159219 + 200 \times 31.074793592 = 282991.7438$$

Finally

$$\Pr(Z < 2000) = \Pr(Y > 6433.186014)$$

$$= \Pr\left(N(0,1) > \frac{6433.186014 - 6214.958718}{531.97}\right)$$

$$= \Pr(N(0,1) > 0.41023) = 1 - 0.65918 = 0.34082$$

Solution

<u>Under C</u>

$\text{Var}(Y) = 200\text{Var}(X) + 200E(X)2$

$\text{Var}(Y) = 200 \times 0.752 \times 402 + 200 \times (0.75 \times 30)2 = 360000 = 6002$

So

$$\Pr(Z < 2000) = \Pr(Y > 6300) = \Pr\left(N(0,1) > \frac{6300 - 6000}{600}\right)$$

$= \Pr(N(0,1) > 0.5) = (1 - 0.69146) = 0.30854$

8 Policy Excess

Insurance policies with an excess are common in motor insurance and many other kinds of property and accident insurance.

Under this kind of policy, the insured agrees to carry the full burden of the loss up to a limit, L, called the excess. If the loss is an amount $\boldsymbol{X}$, greater than L, then the policyholder will claim only $X - L$. If Y is the amount actually paid by the insurer, then:

$$\begin{aligned} \boldsymbol{Y = 0} \quad & \textbf{if } \boldsymbol{X \leq L} \\ \boldsymbol{Y = X - L} \quad & \textbf{if } \boldsymbol{X > L} \end{aligned}$$

Clearly, the premium due on any policy with an excess will be less than that on a policy without an excess.

The position of the insurer for a policy with an excess is exactly the same as that of the reinsurer under excess of loss reinsurance. The position of the policyholder as far as losses are concerned is exactly the same as that of an insurer with an excess of loss reinsurance contract.

Question

CS2A S2023 Q8

An insurer has incurred 10,000 claims under a portfolio of home insurance policies. These claims have a mean size of £2,000 and a standard deviation of £800. One hundred of these claims have exceeded the excess of loss limit on a reinsurance policy that the insurer has in place.

(i) Using a Lognormal distribution, estimate the excess of loss limit on this reinsurance policy. State your assumptions and show all your working clearly. [5]

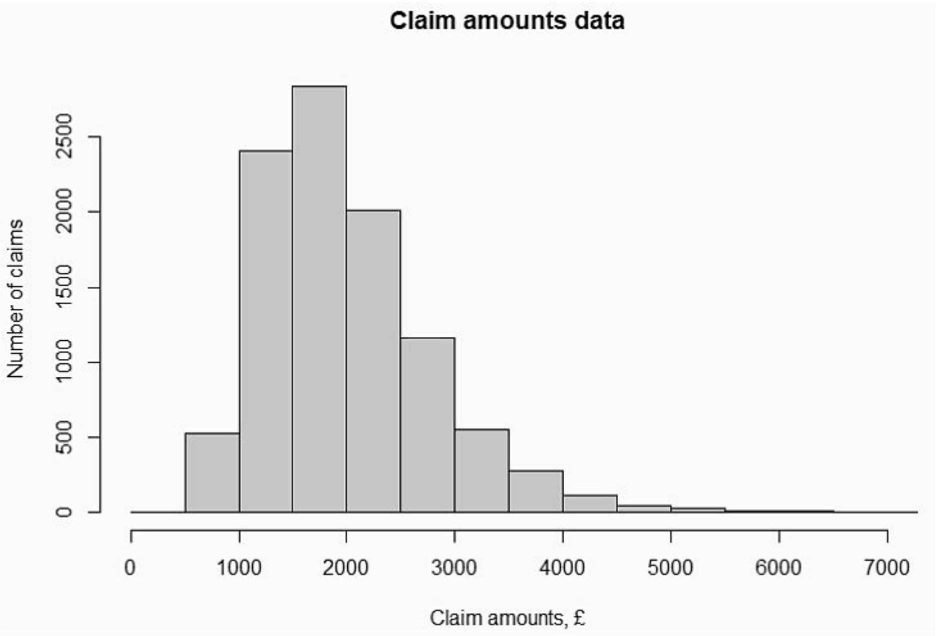
(ii) Calculate the number of claims that would be expected to be less than £1,000. [1]

Question

CS2A S2023 Q8

It has been proposed by the insurance regulator that statutory solvency calculations should be based on modelling claims using a suitable Normal distribution.

(iii) Comment on the appropriateness of using a Normal distribution under various conditions. (You may use the information about the portfolio of policies above to illustrate your answer.) [3]



Question

CS2A S2023 Q8

(iv) Comment briefly on which of the following alternative distributions should be considered, in addition to the Lognormal distribution, when fitting a suitable model to these claims, given the histogram showing the claims data in the figure above, and how you may decide which distribution to include in your final model.

- Gamma
- Exponential
- Weibull.

[5]

[Total 14]

Solution

(i)

mean(y) = exp[mu+0.5*Sigma^2] - - (Eqn 1) [½]

Var(y) = exp[2*mu+ Sigma^2] [exp(Sigma^2)-1] - - (Eqn 2) [1]

squaring Eqn 1

mean(y)^2 = exp[2*mu+Sigma^2] - - (Eqn 3) [½]

dividing Eqn 2 by Eqn 3

var(y)/ mean(y)^2 = [exp(Sigma^2)-1] [½]

Hence:

Sigma = (log((sd(y)/mean(y))^2+1))^0.5 = 0.3852 [½]

Mu = log(mean(y))-0.5*sigma^2 = 7.5267 [½]

P(X>x) = 1-psi(ln(x)-mu/sigma)=0.01 gives x = 4550.2 [1]

Using Invpsi(0.99) = 2.33 [½]

Solution

(ii)
P(X<1000) = psi(ln(1000)-mu/sigma)= 5.41%
So 541 claims [1]

(iii)
The probability of very large claims may be significantly underestimated [½]
leading to potential solvency issues [½]
This is particularly the case for long, fat-talied distributions (leptokurtic) [1]
The distribution gives the theoretical possibility of negative claims [½]
It may be suitable under some conditions [½]
where the claims distribution is not skewed [½]
and has thin-tails [½]
It should be left to the insurer's judgement. [1]
[Marks available 5, maximum 3]

Solution

(iv)

Weibull is potential candidate distribution	[1]
and Gamma is potential candidate distribution	[1]
both can model skewed observation data,	[½]
and are non-negative	[½]
Exponential will not be suitable,	[½]
as it is a decreasing function of x.	[½]
	[Marks available 4, maximum 3]

Decision criteria:

Use AIC/BIC scores	[½]
or calculate the (log) Likelihood	[½]
or carry out a Chi squared test	[½]
or use QQ plots	[½]
May apply Extreme Value Thery to test the tails	[½]
may depend on the model used in previous years	[½]
or on what is typically used by insurers	[½]
	[Marks available 3½, maximum 2]