



Subject: SRM - 2

Chapter: Unit 1

Category: Practice
questions

1. CT6 April 2018 Q2

An insurance company has a portfolio of insurance policies. Claims arise according to a Poisson process, and claim amounts have a probability distribution with parameter q .

- (i) State one assumption the insurance company is likely to make when modelling n aggregate claim amounts. [1]
 - (ii) Explain what the Maximum Likelihood Estimate (MLE) of q represents. [2]
 - (iii) State an alternative to using the MLE. [1]
 - (iv) Suggest two complications that may arise for the insurance company when it uses past claims data to determine the MLE of q . [2]
- [Total 6]

2. 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]

3. CT6 September 2018 Q8

For a portfolio of insurance policies, claims X_i are independent and follow a gamma distribution, with parameters $\alpha = 6$ and β , which is unknown.

A random sample of n claims, $X_1, \dots, X_n$ is selected, with mean $\bar{X}$.

- (i) Derive an expression for the estimator of β using the method of moments. [2]
- (ii) Explain what the Maximum Likelihood Estimator (MLE) of β represents. [2]
- (iii) Derive an expression for the MLE of β , commenting on the result. [5]
- (iv) State the Moment Generating Function (MGF) of X . [1]

Let $Y = 2n\beta \bar{X}$.

- (v) Derive the MGF of Y , and hence its distribution, including statement of parameters. [5]
- [Total 15]

4. CT6 September 2017 Q1

Claim amounts on a portfolio of insurance policies follow a Weibull distribution. The median claim amount is £1,000 and 90% of claims are less than £5,000.

Estimate the parameters of the Weibull distribution, using the method of moments. [4]

5. CT6 April 2017 Q3

(i) Explain why claim amounts from general insurance policies are typically modelled using statistical distributions with heavy tails. [2]

Claim amounts on a portfolio of insurance policies are assumed to follow a Weibull distribution. A quarter of losses are below 15 and a quarter of losses are above 80.

(ii) Estimate the parameters c , γ of the Weibull distribution that fit this data. [3]

(iii) Determine whether or not this Weibull distribution has a heavier tail than that of the exponential distribution with parameter c , by considering your estimate of γ . [2]

[Total 7]

6. CT6 April 2016 Q2

A portfolio of insurance policies has two types of claims:

- Loss amounts for Type I claims are exponentially distributed with mean 120.
- Loss amounts for Type II claims are exponentially distributed with mean 110.

25% of claims are Type I, and 75% are Type II.

(i) Calculate the mean and variance of the loss amount for a randomly chosen claim.

An actuary wants to model randomly chosen claims using an exponential distribution as an approximation.

(ii) Explain whether this is a good approximation.

7. CT6 April 2017 Q2

Claim amounts X_i from a portfolio of insurance policies follow a gamma distribution with parameters k and λ_i . Each λ_i also follows a gamma distribution with parameters α and β .

- (i) Show that the mixture distribution of losses is a generalised Pareto, with parameters α , β , k . [4]

Claim amounts are now assumed to be exponentially distributed with parameter λ_i

- (ii) Show, using your answer to part (i), that the mixture distribution of losses is now a standard Pareto distribution with parameters α , β . [2]

[Total 6]

8. CT6 Oct 2015 Q9

A random variable X follows a gamma distribution with parameters α and λ .

- (i) Derive the moment generating function (MGF) of X .

- (ii) Derive the coefficient of skewness of X .

9. CT6 September 2016 Q5

- (i) (a) Explain what is meant by a sequence of independent, identically distributed (I.I.D.) random variables.

- (b) Give one example of a sequence of I.I.D. random variables. [3]

Claim amounts X_i from a portfolio of insurance policies are assumed to be I.I.D. and exponentially distributed, with parameter λ . In a given year there are n claims.

- (ii) Show that the total claim amounts follow a gamma distribution, specifying its parameters. [2]

In practice the individual claim amounts are not I.I.D. but instead the exponential parameter λ_i varies between each claim. λ_i follows a gamma distribution with parameters α and β .

- (iii) Show that the marginal distribution of claim amounts follows a Pareto distribution with parameters α and β . [5]

[Total 10]

10. CT6 April 2016 Q1

- (i) Derive the median of a Pareto distribution with parameters α and λ . [3]

Let $\alpha = 2$ and $\lambda = 3$.

- (ii) Comment on the skewness of this Pareto distribution. [3]

[Total 6]