ACTL3162 General Insurance Techniques
ACTL5106 Insurance Risk Models
Assignment, 2024 T3

1 Learning outcomes

This assignment is designed to develop the course learning outcomes (CLO5-CLO7) as outlined in the course syllabus. It also evaluate programe learning outcomes in the areas of "Business Knowledge", "Problem solving", and "Business Communication". You are expected to demonstrate your ability to analyse an actuarial problem, apply appropriate relevant theories and logical reasoning to interpret the problem, and formulate solutions and conclusions. The clarity and effectiveness of your communication will also be assessed.

2 TASK 1 [10 marks]

You are an actuary at a general insurance company and have been tasked with analysing the loss severity data for a portfolio of property insurance claims. To improve the risk assessment and pricing strategies, a dataset containing 2,000 loss amounts is given for you to examine the data set and apply different probability distributions to accurately capture the underlying patterns of the loss severity data.

Data: The claims amounts are stored in Loss.csv.

Your task is to use Maximum Likelihood Estimation (MLE) to fit an appropriate loss severity distribution. You are required to fit some probability distributions to the loss data and use appropriate goodness-of-fit tests to decide and subsequently justify which of the four distributions is the most appropriate to use for modelling the loss severity distribution. You may wish to further support your conclusions via graphical approaches.

You must briefly describe your methodology in reaching your MLE estimates of your parameters. Your report should include the answers to the following items:

Complete data

1. Estimate the model parameters for each candidate model (the **Log-normal, Exponential, Gamma, and Pareto** distributions) and present the fitted model.
2. Evaluate the quality of the given model by using graphical approaches and performing hypothesis tests (Note: when there is no grouping in the data, the K-S and A-D tests make more sense than the χ^2-test because no arbitrary decisions need to be made. So you do not have to perform the χ^2-test in this assignment.)
3. Determine the model that fits best using the criteria introduced in the lectures.

Censored data

Assume that there is a policy limit of $\$10,000$ applied to each loss (that is, the maximum amount the insurance company is going to pay).

1. Calculcate MLE estimates of the **Exponential and Pareto** distributons for the right-censored data. Provide the likelihood function for each distribution in Appendix.
2. With the results in 1 for the censored data, produce QQ plots for the Exponential and Pareto distributions.

However, providing detailed mathematical formulas and code snippets is not necessary (but the entire R code or the code of other software if you are not using R must be provided in a separate pdf or word file).

3 Required document

You are asked to provide a **report and R code**. There will be **TWO** submission boxes (one business report and one R code in Moodle.

- The report should provide results for all of the above tasks in word or pdf format. You do not need to provide a table of contents in your report. and should think of a clear and effective structure for your responses. There is no specific formatting requirement; however, you should ensure that the report is professional in the business context.
  - The main body of the report should be **no more than 3 pages** (i.e. maximum 3).
  - Cover pages, appendices and reference lists are not counted towards the page limit.
  - No page limit for the appendix.
  - You need to provide a reference list if any references are used in your report.
- You should **not**
  - Include a chunk of programming codes in the main body of your report
  - Have figures or tables that are not referred to or analysed in the main body of your report
  - Include materials that are not highly relevant in the main body of your report
- Intermediate steps for questions involving any form of derivation are required. Your comments and conclusions should be well justified and charts should be used to support your conclusions where applicable.
- You are **strongly recommended to use the software R for programming**, although the use of other software will also be accepted. Some sample R codes for fitting are available on the course website which may be of use. In addition, feel free find packages online to perform your computations (but always check that your answer is sensible!).
- When making a comment or conclusion based on R outputs (or other software outputs), you should include the relevant outputs in the main body of your report. You should make sure that the marker can read and understand your arguments and statements without referring to the separate R code file.
- Your R codes (or codes of other software) should be included in the separate file. The marker will choose a portion of the reports to check the code. He/she will need to copy the code, run it and check whether it is correct, implementable and consistent with the output presented in your answer. **Students will risk failing the assignment if the code cannot be run or the output provided in the answer is not consistent with the output generated by the code.**

4 Assessment criteria

Please see the file, “Rubric".