ACTUARIAL MODELING FOR INSURANCE CLAIM SEVERITY IN MOTOR COMPREHENSIVE POLICY USING INDUSTRIAL STATISTICAL DISTRIBUTIONS

BY

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INTRODUCTION

General Insurance companies typically face two major problems when they want to use past or present claim amounts in forecasting future claim severity.

- Appropriate statistical distribution of claim
- Testing how well this statistical distribution fits their claims

OBJECTIVES

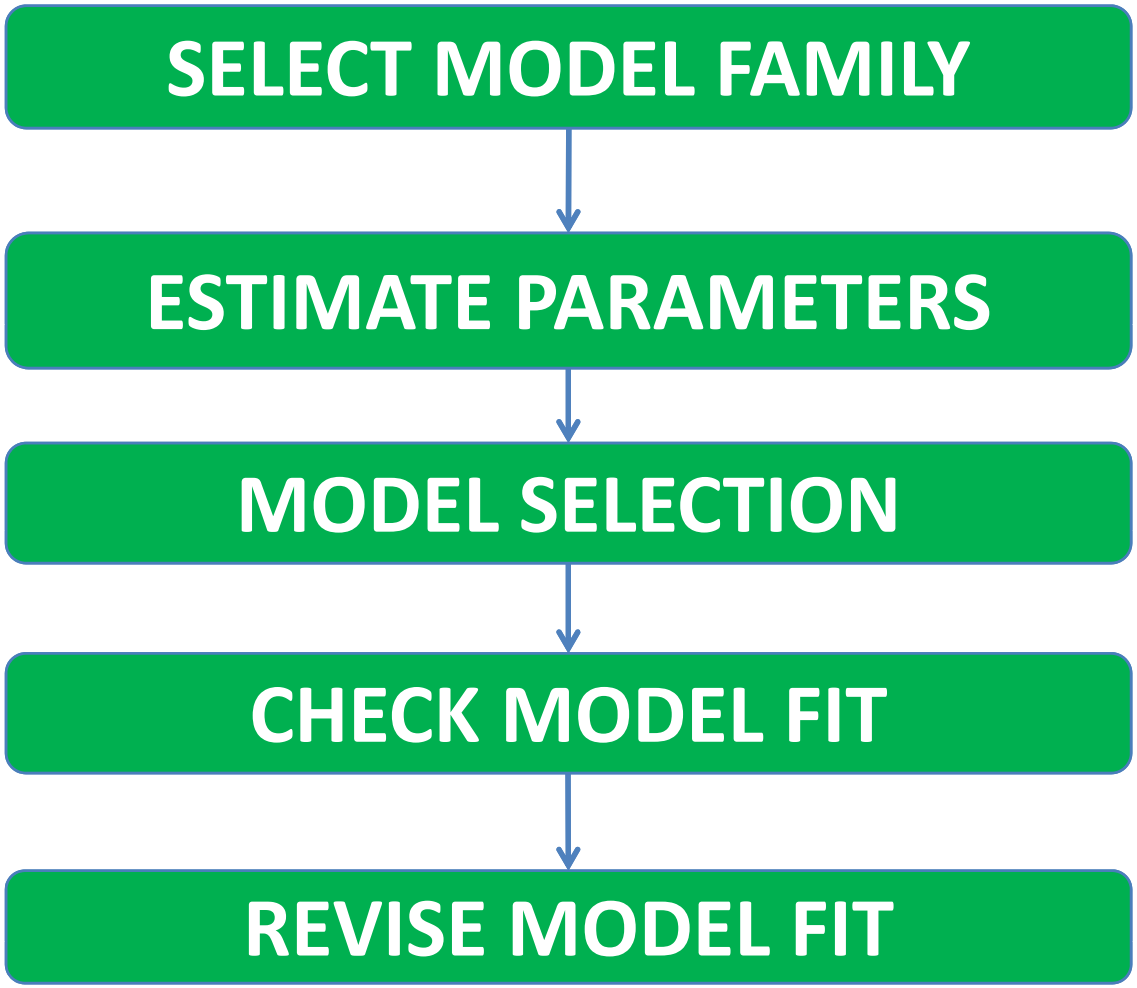
- Research aimed at:
  - Establishing one statistical distribution that could efficiently model the claim amounts
  - Testing goodness of fit as follows:
    - Mathematically (Akaike's Information Criterion - A.I.C)
    - Graphically (Quantile-Quantile Plots- Q-Q plots).

EXCECUTIVE SUMMARY

Steps followed in the modeling process:

- Selecting a model family
- Estimating model parameters
- Specification of the criteria to choose one model from the family of distributions
- Check model fit
- Revise model fit if necessary

STEPS IN MODELLING



VARIABLE

- The variable modelled was claim amounts from First Assurance Company limited, motor comprehensive policy (June 2006-June 2007).

- This modeling process was aided by the **MATLAB** software

SELECT MODEL FAMILY

Therefore four statistical distributions were used, these included:

- Gamma
- Exponential
- Lognormal
- weibull

MAX. LIKELIHOOD ESTIMATOR

- Let X_i be the ith claim amount, where $1 \leq i \leq n$.

  n = number of claims in the data set

  L = likelihood function

  θ is the parameter

  f(x) is the probability distribution function of a specific distribution

MAX. LIKELIHOOD ESTIMATOR

- The likelihood function is given by:

  $L = \prod f(X)$..... (1)

  To get maximum likelihood, differentiate equation (1)

  $M.L.E = \delta L / \delta \theta$..... (2)

  Therefore to solve the value of the parameter, equate equation (2) to zero:

  $\delta L / \delta \theta = 0$..... (3)

SELECTING ONE DISTRIBUTION

- The criteria for choosing one distribution out of the four was based on the values of the estimated maximum likelihood estimator

- The larger the Maximum likelihood estimator, the better the model

CHECKING MODEL FIT

- Just because a distribution got the highest likelihood out of the four distributions is not sufficient evidence to show that its the right distribution for the claims data

- Therefore to check for the goodness of fit of the distribution to the claims data Q-Q (Quantile-Quantile) plots were used

THE Q-Q PLOTS

- First Q - stands for the quantiles of the sampled data set
- Second Q stands for the quantile of the distribution being checked
- The Q-Q plot is a plot of the target population quantile(y) against the respective sample quantile (x)

AKAIKE'S INFORMATION CRITERION (A.I.C)

A.I.C criterion is defined by:

A.I.C = -2 (Maximum log-likelihood) +

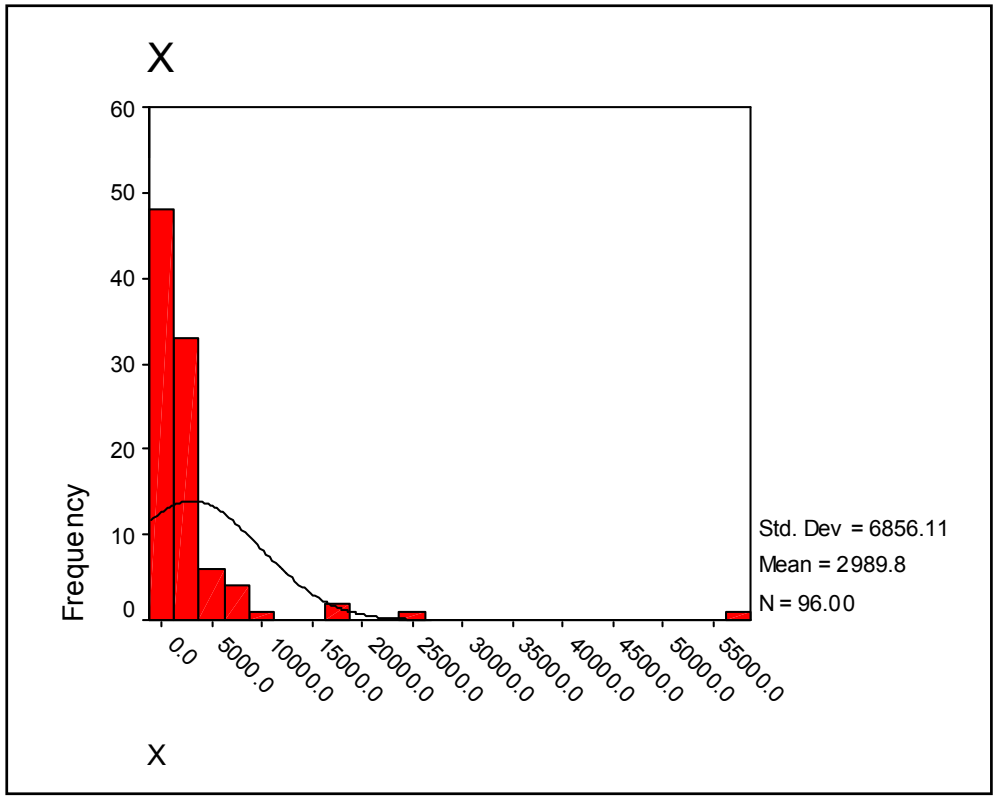
2 (No. of parameters estimated)

This was computed using a calculator

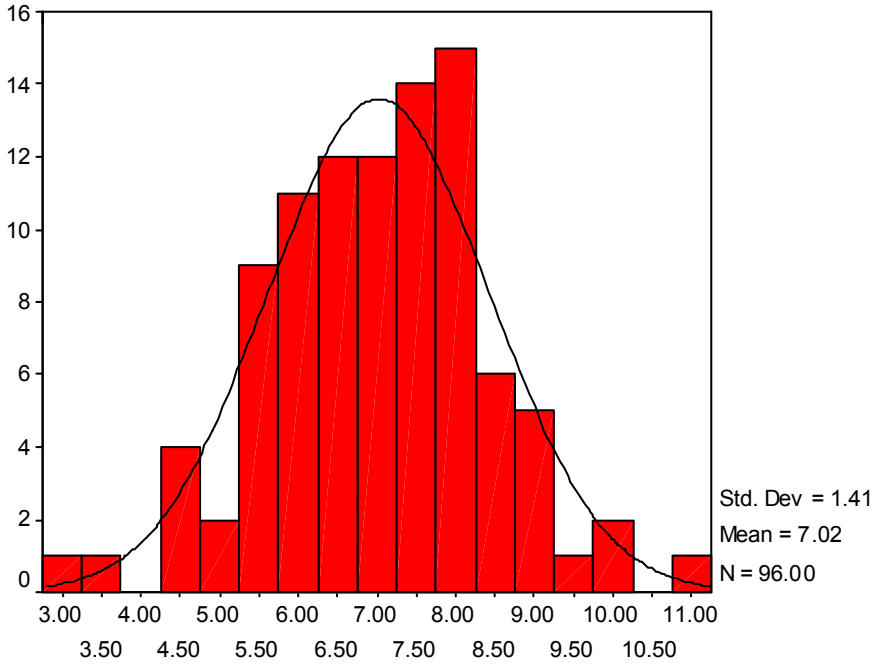
SUMMARY STATISTICS

N	Mean	Median	Mode	Skewness	Sum
125	148002.8	41978	11020	4.1	18500349

HISTOGRAMS OF CLAIMS



HISTOGRAM OF TRIPLE LOG



MAX LIKELIHOOD ESTIMATES

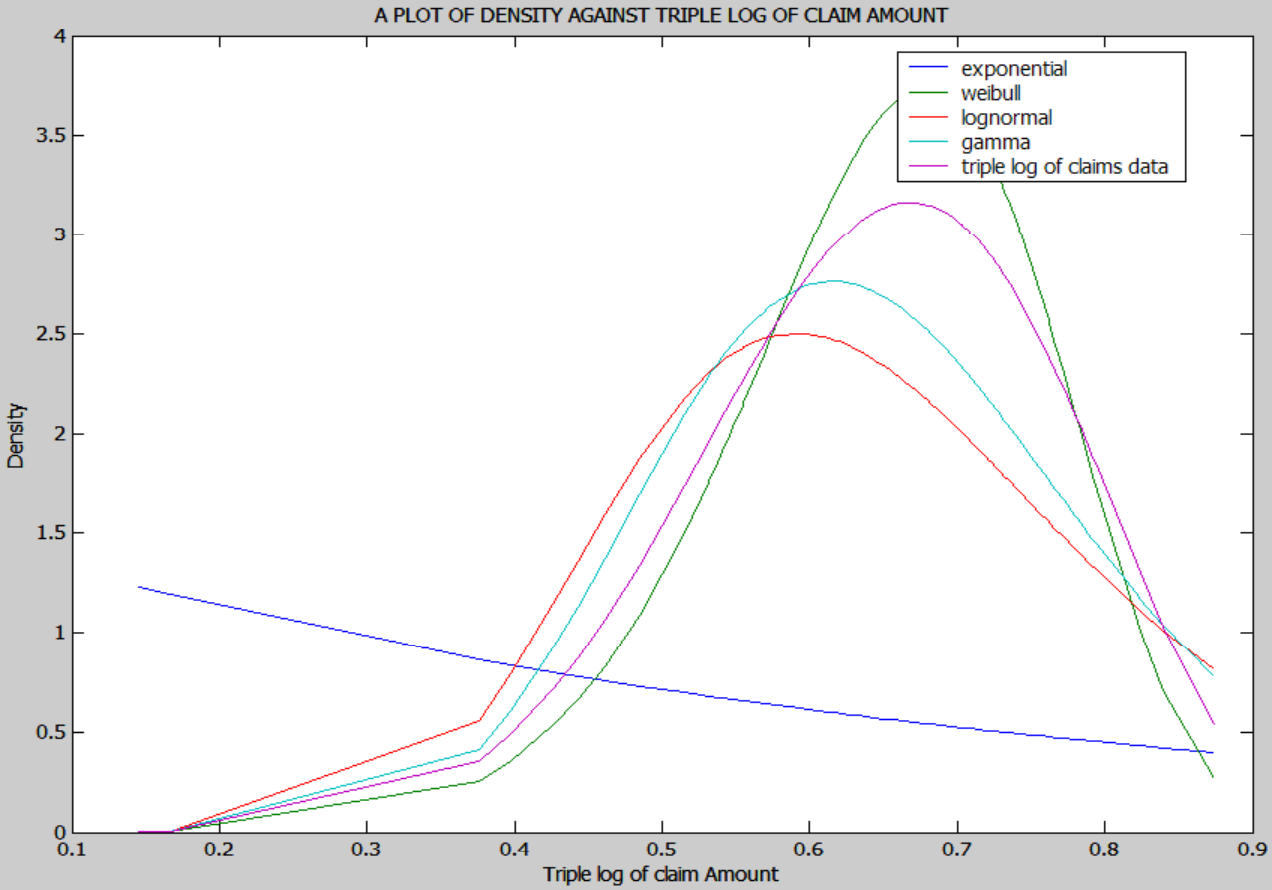
- The first step in fitting a model to a claims data is finding the parameter estimates of the particular statistical distribution.

- Table 4.2 below gives the parameters of the four distributions Where:
  - μ was taken to be the value of the first parameter
  - δ was taken to be the second parameter value

PARAMETERS

Distributions	Log-Likelihood	A.I.C	μ	δ
Exponential	-109.6749	221.3500	0.8609	
Lognormal	182.0632	-360.1300	-0.1517	0.0628
Gamma	-6460.9000	12925.8000	255.8749	0.0034
Weibull	174.8366	-345.6700	0.8865	16.6898

PROBABILITY DENSITY FUNCTION



THE GOODNESS OF FIT TEST

- The central problem in analysis is which model to use for making inferences from the data- this is the model selection problem.
- The goodness of fit test was done both mathematically and affirmed graphically.
- This called for computation of the Akaike's Information Criterion (A.I.C) and plotting of the Q-Q plots

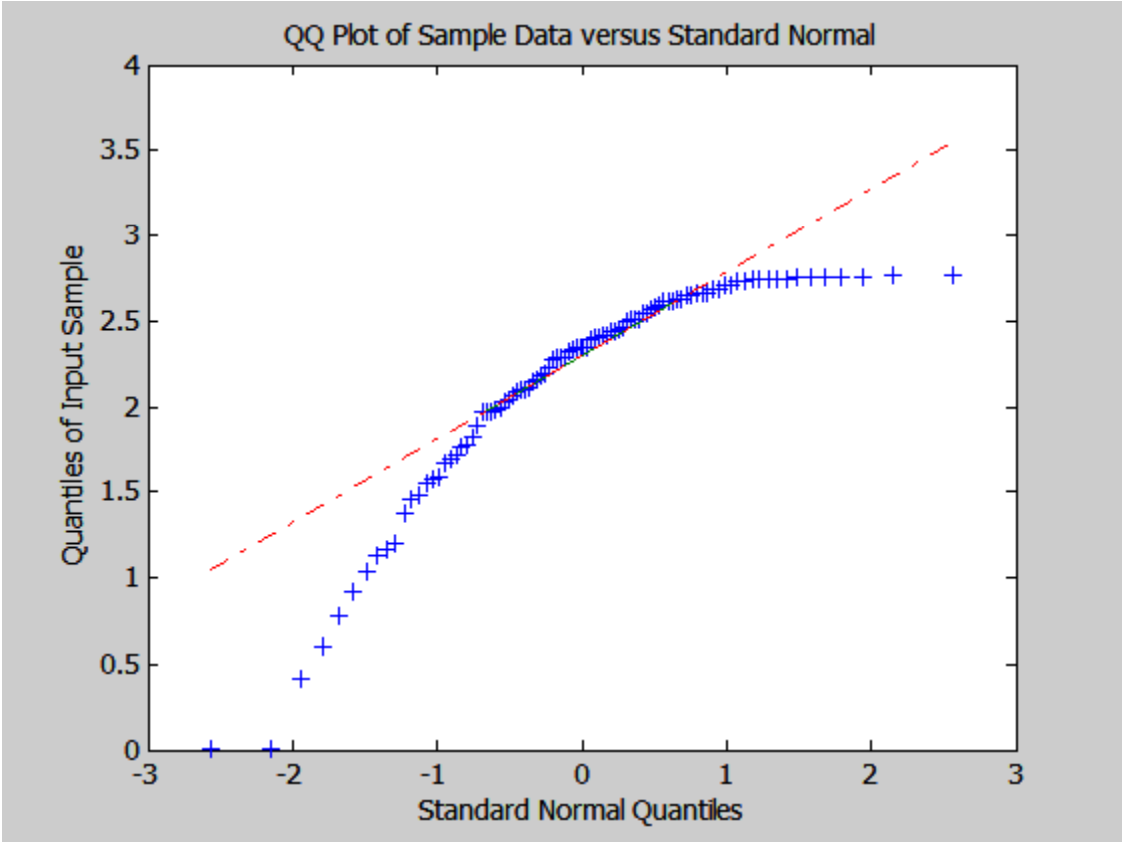
THE A.I.C INTERPRETATION

- In AIC one should select the model with the **smallest** value of AIC. With this regard the log-normal distribution had the smallest value of AIC.
- The log-normal distribution was estimated to be the closest to the unknown true distribution among the four candidate distributions considered

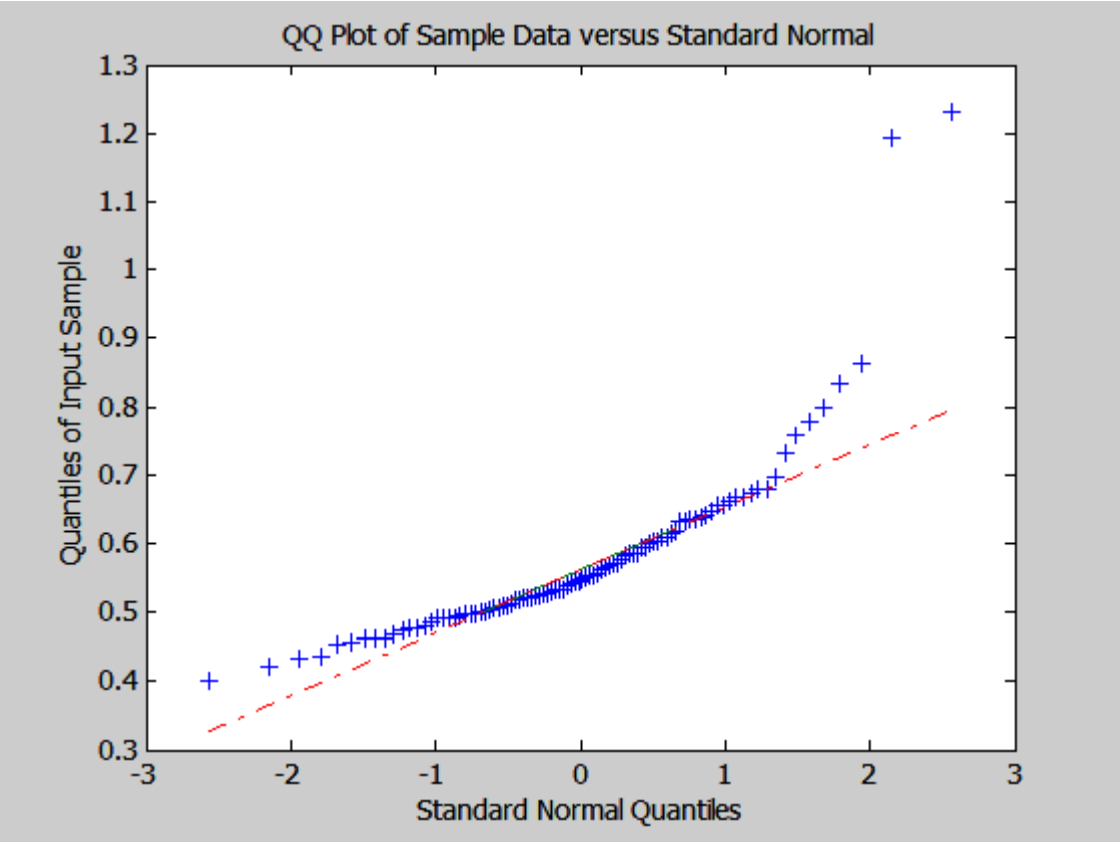
THE Q-Q PLOTS

- The Q-Q plots were constructed, and the selection criterion was based on the hypothesis below:
- **H0**: The statistical distribution provides the correct statistical model for the claims data
- **H1**: The statistical distribution does not provide the correct statistical model for the Claims data

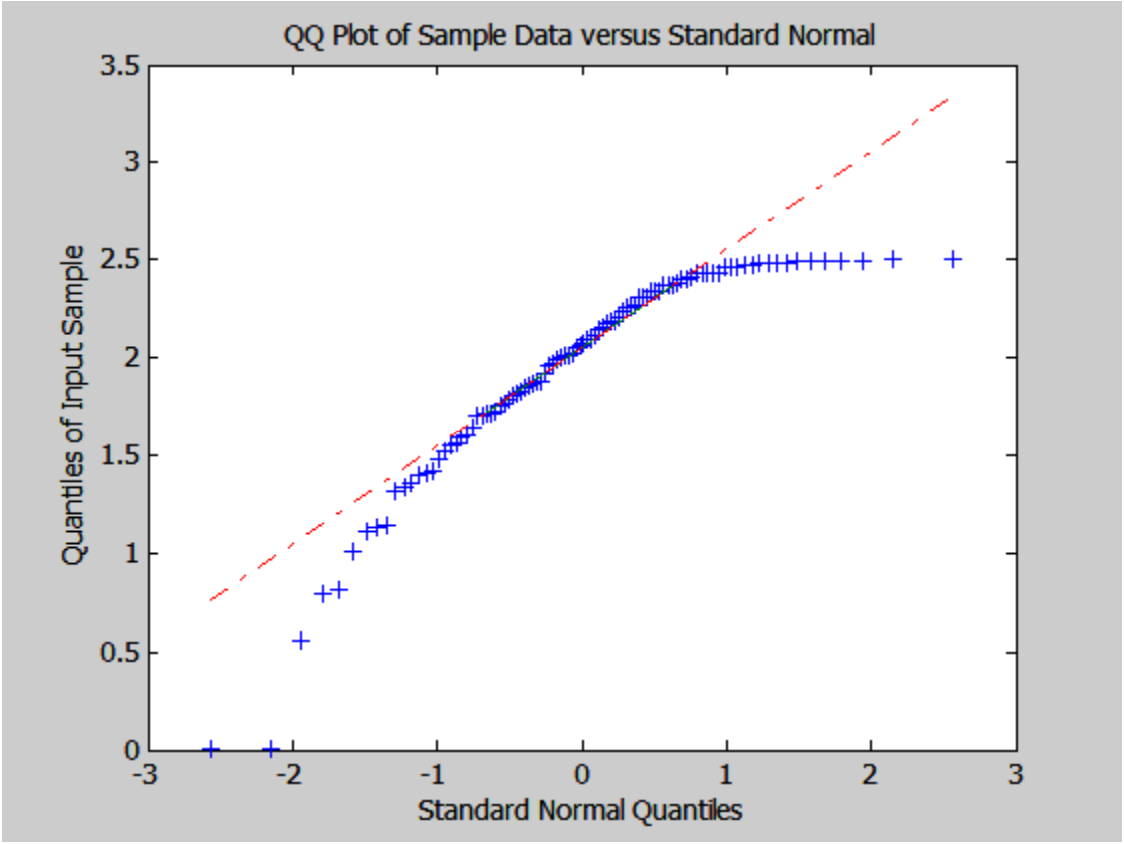
Q-Q PLOT OF GAMMA DISTRBN



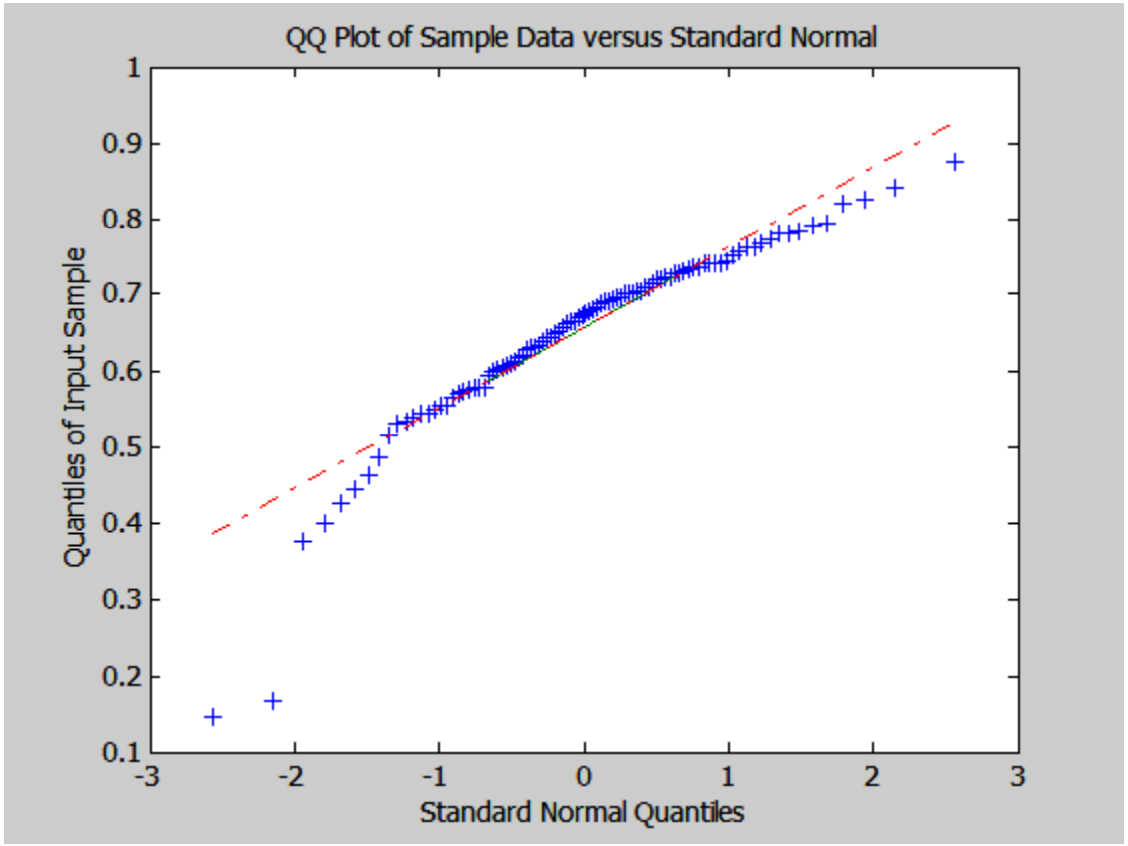
Q-Q PLOT OF EXPONENTIAL DISTRBN



Q-Q PLOT OF WEIBULL DISTRBN



Q-Q PLOT OF LOG-NORMAL DISTRBN



CONCLUSION OF THE Q-Q PLOTS

- The null hypothesis was not rejected for the lognormal distribution.
- Therefore a conclusion was made that at 99% level of confidence, the log-normal distribution provides the correct statistical model for the claims data.

CONCLUSION

- However the results of this study are dependent on a number of factors outside the modeling process.
- This means that the insurance company has to acknowledge these factors before using the results of this study in making future inferences. These factors include:

FACTORS TO CONSIDERED

I. Future claim amounts to be experienced by the insurance company may depend on an increase in **recklessness of drivers**

II. **Change of road traffic policies** may reduce future claims amounts. This maybe as a result of more traffic police-men being employed along the roads

FACTORS TO CONSIDER

III. **Increase in awareness** of the general public on the advantages of comprehensive insurance may lead to more claims amounts as more people would be moving from Third party (TPO) Insurance to Comprehensive insurance.

IV. **Increase of the number of motor vehicle** may alter the expected future claim amounts

LIMITATIONS

- However In adopting the actuarial modeling process displayed in this paper, the following are some of the likely limitation accompanying the results:

1. An assumption was made on the **absence of zero claim amounts** which in reality exists in comprehensive insurance policy.

LIMITATIONS

2. The choice of the **statistical distributions to be used was limited by the software** used in this research.

3. This research assumed that **all the claim amounts experiences between June 2006 and June 2007 were all reported**.

THE END

QUESTIONS??