

Introduction to Actuarial Models

Assignment - 1

1. The steps in the development of a model will be as follows :-
 - i. Set well-defined objectives for the model. In this case the model is being made to project the assets and liabilities of an insurer after one year. The objective here is to account for the change in the regulatory capital requirement. Now sufficient capital must now be held such that there is less than a 0.5% chance of liabilities exceeding assets after one year.
 - ii. Plan the modelling process and how the model is validated. The worst-case scenarios should be considered while planning the model. The “worst-case scenarios” can be huge loss ratios , high inflation , etc.
 - iii. Then the necessary data is to be collected from an appropriate source. A credible data source can be the past data collected by the insurance company.
 - iv. Then the parameters are to be defined and values should be assigned to them in an appropriate range.
 - v. The model should be defined at a basic level based on the real world system and it can be refined later.
 - vi. The experts on the real-world system should be involved to check the validity of the model and to refine the model.
 - vii. An appropriate computer software should be decided upon and then the computer program .
 - viii. Any errors in the model should be rectified and the model should be debugged
 - ix. Sensitivity should be checked by making small changes in the parameter values. Ex. The changes in the output of the model due to small changes in the interest rates.
 - x. The output of the model should be analysed and its results should be communicated efficiently. The results should also be documented.

- 2 . A stochastic model has been developed to project option and guarantee costs. This model has been used to estimate the probability that the insurance company will have insufficient assets to honour the payouts under the policies.

The factors that may cause inaccuracy in the probability can be

- i. Models rely heavily on input data so if there are some inaccuracies in the input data , then there is a chance the probability estimated may be flawed.
- ii. It is a stochastic model which means that it takes a range of input data and provides us with a range of output. With the help of this we can check various scenarios. However , the model cannot take into account all future events. A significant change in the future for ex. Change in tax rates , interest rates or any change in the law , may make the estimates of the model unreliable.
- iii. The parameters taken in the model may not represent the real-world system precisely .
- iv. The estimates and the actual return on the investments may have a high deviation.

3.

1. The objective should be clearly stated. The reason behind the development of a model for predicting future mortality should be defined.
2. Existing relevant data could be collected from an appropriate source which is in line with the objective. Ex Past mortality data from a government body can be used .
3. Then the parameters can be determined with the help of the model.
4. The computer code can be written and the model can be implemented.
5. The model should be debugged and can be refined if there are any inaccuracies.
6. How sensitive the parameters are with each other should be checked
7. The output can be analysed then
8. Based on the above step we can identify what type of model is appropriate.

We can validate model to check its reliability by back-testing it.

4. The items that should be included are as follows :-

- i. The objective and the purpose of the model should be mentioned.
- ii. Any assumptions made while making the model
- iii. Explanation of the working of the model
- iv. The type of the model i.e whether it is stochastic or deterministic

- v. Details about the input data used
- vi. The results of the model explained in technical as well as non-technical words for better communication.

5. Advantages are as follows :-

- i. The model uses age-specific consumption rates to forecast age-specific consumption rates for the next 20 years. As age is taken as a single source of variation here for the estimation , the model is simple and easy to understand.
- ii. Past data is being extrapolated to project future consumption rates. This data is fairly reliable as it is collected by the company itself.
- iii. The model is not too complex and its functioning can be easily communicated to people even with non-technical background.
- iv. Due to the simplicity of the model , the cost will be relatively less.

Disadvantages are as follows :-

- i. The age-specific consumption rates are extrapolated to obtain the data for the next 20 years . However they may not represent the future consumption accurately.
- ii. Age may not be the single factor affecting the demand.
- iii. Price is an important factor that affects the demand of the product.
- iv. As people are becoming more health-conscious , the demand in the future may not increase as estimated.

6.

- 1. The second actuarial student may have made some mistake while running the model.
- 2. The change in the value of the parameter may have a greater impact on the output.
- 3. Different random sample may have been used by the second student.
- 4. Some changes may have been made in the data.
- 5. The assumptions taken may be different by the two students.

7.

- i. The model is fairly simple and not too complex.
- ii. The current fertility and mortality rates are considered. However in these rates may not sustain in the future. It is better to study the pattern in them.
- iii. A situation like a pandemic may have a huge impact on the mortality rates.
- iv. The initial population distribution estimate may be incorrect.
- v. The reliability of the data should be checked and the model should be back-tested.
- vi. The population distribution estimates are based on the rural age distribution and the planned town may have a different age distribution.

8.

- i. The type and reliability of the data should be considered . The simplicity or complexity of the model depends on the data.
- ii. The modelling process and the data collection should be well planned so as to manage the cost .
- iii. The type of the model should be determined i.e deterministic or stochastic model
- iv. The general trends in the sickness of the population should be considered.
- v. The sensitivity of the parameters should be checked.
- vi. A scenario-based model should also be considered . For ex. A pandemic may affect the sickness level in the population
- vii. The age group of the employees also affects the sickness rates. Ex If majority of the employees fall in the older age group , then they will be more prone to falling sick.
- viii. The benefit under the sick pay scheme should be clearly determined.