

INTRODUCTION TO ACTUARIAL MODELLING
ASSIGNMENT-1
ROLL NO.- 38

1. Steps-

- a. Develop a well-defined set of objectives that need to be met by the modelling process.
Objective- A cashflow model to project assets and liabilities of an insurer after one year such that there is less than a 0.5% chance of liabilities exceeding assets after a year.
- b. Plan the modelling process and how the model will be validated.
- c. Collect and analyse the necessary and valid data for the model. For example- past policy data from IRDAI, reinsurer, trade magazines etc.
- d. Define the parameters for the model and consider appropriate parameter values. For example- expenses, market data.
- e. Define the model initially by capturing the essence of the real-world system. Refining the level of detail in the model can come at a later stage. Consider existing “worst case” scenarios and their probabilities like mortality rate being higher due to pandemic.
- f. Involve experts on the real-world system you are trying to imitate to get feedback on the validity of the conceptual model.
- g. Decide on whether a simulation package or a general-purpose language is appropriate for the implementation of the model. Choose a statistically reliable random number generator that will perform adequately in the context of the complexity of the model.
- h. Write the computer program for the model.
- i. Debug the program to make sure it performs the intended operations in the model definition. For example- check for expected output for simple scenarios.
- j. Test the reasonableness of the output from the model. For example – probabilities of “worst case” scenarios.
- k. Review and carefully consider the appropriateness of the model in the light of small changes in input parameters.
- l. Analyse the output from the model. For example- capital requirement.
- m. Communicate and document the results and the model.

2. Factors causing probability to be inaccurate:-

- a. Models rely heavily on the data input. If the data quality is poor or lacks credibility, then the output from the model is likely to be flawed.
- b. Data may have errors or may be inaccurate causing the output to be inaccurate.
- c. Model chosen initially in line with real-world process may not turn out to be reasonable.
- d. Some future events, such as legislative changes which affect the interpretation of policy conditions, wouldn't have been anticipated in the modelling.
- e. Model might be highly sensitive to the parameters chosen and the parameters are estimates because the true underlying parameters cannot be observed.
- f. Model might be too complex to be verified.

3. a. Develop a well-defined set of objectives that need to be met by the modelling process, i.e. state the point of the exercise. In this case- to forecast future mortality.

- b. Plan the modelling process and how the model will be validated.
- c. Collect and analyse the necessary data for the model. In this case we would need the numbers of deaths over the past years.
- d. Define the parameters for the model and consider appropriate parameter values. Like mortality rates, past trends, situations like pandemic.
- e. Define the model firstly by capturing the essence of the real-world system. Refining the level of detail in the model can come at a later stage. For this model, this means we should identify the main features of mortality.

- f. Involve people with expert knowledge of the real-world system you are trying to imitate so as to get feedback on the validity of the conceptual model. For example, there may be a government department that can help.
 - g. Decide on whether a simulation package or a general-purpose language is appropriate for the implementation of the model.
 - h. Write the computer program for the model.
 - i. Debug the program to make sure it performs the intended operations defined in the initial modelling process.
 - j. Test the reasonableness of the output from the model. For example, we could check that it is a good fit to the actual mortality experience of the country over last 30-50 years.
 - k. Test sensitivity.
 - l. Analyse the output from the model.
 - m. Ensure that any relevant professional guidance has been complied with. This may include standards on data, modelling and reporting.
 - n. Document the results of the model and communicate these to the government.
4. Items that would be included under documentation: -
- a. Summary of the output of the model.
 - b. Objective of the model.
 - c. Assumptions underlying the model.
 - d. Definition of input data and parameters.
 - e. Whether the model is stochastic or deterministic.
 - f. References of research papers that might be used.
 - g. Adaptation source of the model.
5. Advantages: -
- a. The model is simple to comprehend and run.
 - b. Inexpensive model.
 - c. Past data on consumption are closely accurate.
 - d. The model takes into account future behaviour of consumption and age.

Disadvantages: -

- a. Past consumption trends may not be appropriate to consider for future.
 - b. Extrapolation might be complex.
 - c. Some other competitive product might come in market affecting sales.
 - d. The projections of the future population by age may not be accurate, as they depend on future fertility, mortality and migration rates.
 - e. The proposed strategy does not include any testing of the sensitivity of total demand to changes in the projected population, or variations in future consumption trends from that used in the model
6. Results are different because: -
- a. Either the first or the second or both of the runs may have been incorrect. Like the second trainee might have used different assumptions.
 - b. The expectation of sensitivity of the model to that parameter could be wrong.
 - c. Data might have been amended over time.
7. Appropriateness of the model: -
- a. The method used is direct to apply and understand.
 - b. The model does not take into account citizens moving in or out of the town (migration), which is an important factor affecting population size.
 - c. If the area belongs to a developed country, mortality will have a low effect so this parameter can be ignored to simplify the model.
 - d. Outputs will be reliable and accurate for short term but become less reliable for long term.
 - e. The model assumes that the initial population profile of the town will be the same as for

- the rural area in which it is located, which may not be true for a new town.
- f. The initial population profile will depend on the type of housing and the type of employment opportunities available in the town.
 - g. Fertility rates will be specific to areas depending on health care conditions etc. so a standard fertility rate would not be appropriate.
 - h. There should be accurate age distribution data.
 - i. School going population may not be equal to actual population of children because of factors like poverty or backward mindset.
 - j. Fertility and mortality rates of children of children may decrease in future because of nuclear-family trend and with increasing inflation it might not be possible for families to be financially stable enough to conceive a child in future.
8. Factors: -
- a. General sickness trend.
 - b. Nature of existing sickness data of company.
 - c. The complexity of the model – e.g. whether it should be stochastic or deterministic. More complex models will be costlier to prepare and run, but eventually there may be diminishing returns to additional complexity.
 - d. Budget, resources and staff available for constructing the model.
 - e. Factors such as pandemic need to be taken into account.
 - f. Characteristics of employees, such as age, smoking/drinking habits.
 - g. The definition of sickness and benefits payable under the scheme.