

INTRODUCTION TO ACTUARIAL MODELS

1. You have been commissioned to develop a model to project the assets and liabilities of an insurer after one year. This has been requested following a change in the regulatory capital requirement. Sufficient capital must now be held such that there is less than a 0.5% chance of liabilities exceeding assets after one year. The company does not have any existing stochastic models, but estimates have been made in the planning process of "worst case" scenarios. Set out the steps you would take in the development of the model.

Answer:

- Planning the modelling process and how the model will be validated.
- Collecting and analysing the necessary data for the model.
- setting parameters and their appropriate values.
- taking feedback on the parameters from experts.
- creating a simulation based on the worst-case scenario available.
- Writing a computer program for the model.
- Debugging the program to make sure it performs the intended operations in the model definition.
- Testing the reasonableness of the output from the model.
- Reviewing and carefully considering the appropriateness of the model in the light of small changes to the input parameters.
- Analysing the output from the model.
- Ensuring that any relevant professional guidance has been complied with.
- Communicating and documenting the results and the model.

2. An insurance company has a block of in-force business under which policyholders have been given options and investment-related guarantees. A stochastic model has been developed which projects option and guarantee costs. You have used the model to estimate, for the Company Board, the probability of the insurance company having insufficient assets to honour the pay-outs under the policies. A Board member has asked whether there are any factors which could cause this probability to be inaccurate. Outline the items you would mention in your response.

ANSWER: There are several factors which could cause the probability to be inaccurate, such as:

- The parameters set for the models may be wrong.
- Since this is a stochastic matter the outcome cannot be fully trusted due to its random nature.
- The data entered is inaccurate.

3. The government of a small country has asked you to construct a model for forecasting future mortality.

Outline the stages you would go through in identifying an appropriate model.

ANSWER:

I will Develop a well-defined set of objectives that need to be met by the modelling process.

Plan the modelling process and how the model will be validated.

Collect and analyse the necessary data for the model.

Define the parameters for the model and consider appropriate parameter values.

4. You work for a consultancy which has created an actuarial model and is now preparing documentation for the client.

List the key items you would include in the documentation on the model.

ANSWER: The communication must be such that it takes account of the knowledge of the target Audience Comprehensive documentation should contain sections on model inputs, calculations, outputs, limitations, associated business processes, governance practices, application and platform specifics and their viewpoint.

5. Ten years ago, a confectionery manufacturer launched a new product, the Scrummy Bar. The product has been successful, with a rapid increase in consumption since the product was first sold. In order to plan future investment in production capacity, the manufacturer wishes to forecast the future demand for Scrummy Bars. It has data on age-specific consumption rates for the past ten years, together with projections of the population by age over the next twenty years. It proposes the following modelling strategy:

- extrapolate past age-specific consumption rates to forecast age-specific consumption rates for the next 20 years
- apply the forecast age-specific consumption rates to the projected population by age to obtain estimated total consumption of the product by age for each of the next 20 years
- sum the results to obtain the total demand for each year.

Describe the advantages and disadvantages of this strategy.

ANSWER: Advantages:

- ☐ Using the past data to predict the future
- ☐ The board of directors can get a rough idea about the future of the company
- ☐ Provides a rough idea about the future prospect of the company

Disadvantages:

- ☐ There may be a demographic shift considering that it has been 2 years
- ☐ The past data maybe unreliable
- ☐ We can't accurately predict the future based on the past data
- ☐ We don't know if the same age group would prefer scrummy bar in the next 20 years or so.

6. Following a review of the results of a stochastic model run, an actuary requests that a parameter is changed. The change is not expected to alter the results significantly, but results on the final basis are required in order to complete a report. Unfortunately, the actuarial student who produced the original model run is away on study leave, and so the revised run is assigned to a different student. When the revised results are produced, they are significantly different from the original results.

Discuss possible reasons why the results are different.

Answer: There can be several reasons for the difference in the two observed results the major reasons are:

The documentation of the model maybe inappropriate and therefore the results come out to be different.

Another significant argument for the same could be that, since it is a stochastic model the input that could be completely different from the later.

7. A new town is planned in a currently rural area; A model is to be developed to recommend the number and size of schools required in the new town. The proposed modelling approach is as follows:

The current age distribution of the population in the area is multiplied by the planned population of the new town to produce an initial population distribution. Current national fertility and mortality rates by age are used to estimate births and deaths, the births and deaths are applied to the initial population distribution to generate a projected distribution of the town's population by age for each future year, and hence the number of school age children.

Discuss the appropriateness of the proposed modelling approach.

ANSWER: Right of the bat I don't understand the logic behind multiplying current age distribution of the population to the planned population of the new town. And also considering the fact that national fertility and mortality rates by age are used to estimate births and deaths it is totally reasonable to assume that the national rates could be far deviated from the towns rates. And therefore could make a significant impact on the future projection. Thus I conclude that the model is inappropriate.

8. A large company wishes to construct a model of sickness rates among its employees to use in evaluating the present and future financial health of its sick pay scheme. Outline factors which the company should take into consideration when developing the model.

ANSWER: The various factors that could be considered here are:

- ☐ Age and gender of the employees
- ☐ Past medical records
- ☐ Daily routine/ lifestyle of an average employee
- ☐ Fitness level among various age groups of employees
- ☐ Work hours
- ☐ Stress
- ☐ Pollution in the city
- ☐ Office environment
- ☐ Diet of an average employee.