

ITAM ASSIGNMENT-1

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.

Solution:

- Review the regulatory requirement.
- Define the model's scope, including which factors should be stochastically modelled.
- Plan the model's development, including how it will be evaluated and tested.
- Consider different types of models before deciding on and documenting your preferred method. This may include discussions with specialists on the underlying stochastic processes, if necessary.
- Collect any necessary data, such as historical losses or policy information.
- Decide on parameters. Economic variables should be able to adjust to market data. Other considerations, such as expenses and claim pay outs, must be discussed with staff.
- Existing "worst case" scenarios. Discuss with staff who made the estimates, especially to gauge views on the probability of events occurring.
- Decide on the software to be used for the model.
- Write the computer programs.
- Check if the model operates as predicted for simple, defined situations to debug the software.
- Review the reasonableness of the output. May include:
 - i. median outcomes (how do these compare with business plans)
 - ii. what probability is assigned to worst case scenarios
- Test the sensitivity of the model to small changes in parameters.
- Calculate the capital requirement.
- Communicate findings to management. Document.

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 payouts 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.

Solution:

- The data that is provided might have a lot of outliers which could cause the probability to go up
- The data provided might not be credible
- Since it is a stochastic model it needs a lot of attempts to connect the model with the statistical theory
- Also the probability would be random each and every time

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.

Solution:

- Objective of a model to determine the future mortality of a small country.
- We can take data from Hospitals, Government bodies, Funeral places, Insurance Companies, etc.
- We can take parameters for this model like age, gender, past mortality rate, health policies.
- Then go for verification of the data, for e.g.: check whether there are any missing values, is there is any error of double count.
- Then go for cleaning of the data.
- Transform data in which it can be used for the model i.e. in descriptive, Inferential and predictive, etc.
- Model the data & then communicate the result with the assumption of the assumption of interest rate & the population rate are constant.
- Finalise the model after verified by model expert.

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Solution:

Instructions on how to run the model

- Tests performed to validate the output of the model.
- Definition of input data.
- Any limitations of the model identified (e.g. potential unreliability).
- Basis on which the form of the model chosen (e.g. deterministic or stochastic).
- References to any research papers or discussions with appropriate experts.
- Summary of model results.
- Name and professional qualification.
- Purpose or objectives of the model.
- Assumptions underlying the model.
- How the model might be adapted or extended.

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 modeling 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.

Solution:

Advantages

- The model is simple to understand and to communicate.
- The model takes account of one major source of variation in consumption rates, specifically age.
- The model is easy and cheap to implement.
- The past data on consumption rates by age are likely to be fairly accurate.
- The model can be adapted easily to different projected populations OR takes into account future changes in the population.

Disadvantages

- Past trends in consumption by age may not be a good guide to future trends.
- Extrapolation of past age-specific consumption rates may be complex or difficult and can be done in different ways.
- Consumption of chocolate may be affected by the state of the economy, e.g. whether there is a recession.
- Factors other than age may be important in determining consumption, e.g. expenditure on advertising.
- Consumption may be sensitive to pricing, which may change in the future.
- A rapid increase in consumption rates is unlikely to be sustained for a long period as there is likely to be an upper limit to the amounts of Scrummy Bars a person can eat.
- The projections of the future population by age may not be accurate, as they depend on future fertility, mortality and migration rates.
- 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.
- Unforeseen events such as competitors launching new products, or the nation becoming increasingly health-aware, may affect future consumption.
- The consumption of Scrummy Bars may vary with cohort rather than age, and the model does not capture cohort effects.

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.

Solution:

The possible reasons for the model giving different output-

- The assumptions used by the earlier student were not clear to the new one so he developed a different model.
- The assumptions used by both the people might be different
- There might not be proper communication that might be written by the earlier student who developed the model
- The model might not be relevant due to regulatory changes
- There might be change in the economic policies of the country so the model had to be changed

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 modeling 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.

Solution:

this approach which is used to develop the model is appropriate as the best estimate of the future and probability of the would be received by the age distribution, fertility rates and mortality rates as it would provide an estimate the amount the population is projected to grow year on year' another factor that would should be taken into consideration in the model is the measures taken by the government to control the population and the adoption rate in the town as it would also increase the population.

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.

Solution:

- The nature of the existing sickness data the company possesses. The model can only be as complex as the data will allow it to be.
- Whether the company has made any previous attempts to model sickness rates among its employees, and how successful they were.
- 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.
- General trends in sickness at the national level may need to be built in.
- The definition of sickness and level of benefits payable under the scheme.
- Does the company plan to change the characteristics of the employees? For example, does it plan to recruit more mature persons?
- The ease of communication of the model.
- The budget and resources available for the construction of the model.
- Capability of staff. Will outside consultants be required?
- By whom will the model be used? Will they be capable of understanding and using it?
- Does the model need to interface with models of other aspects of the company's business (e.g. taking data from other systems)?
- The independence of sickness rates should be taken into account e.g. in the event of an epidemic claims cannot be considered independent.