

Assignment-1

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Subject: Introduction to Actuarial Model

Section: TY-B.

- (1) You have been commissioned to develop a model to project the assets & liability of an insurer after a 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 0.5% chance of liabilities exceeding assets after one year.

The Company doesn't have any existing stochastic model, but estimate have been made in the planning process at 'worst case' scenarios.

Set out the steps you would take in the development of model.

Soln

The steps to be considered while development of Project are:

- (i) The objective for this model is to that its ^{liability} do not exceed the ~~0.5%~~ ^{99.5%} probability.
- (ii) We can process the model by taking the data & check the validity of the data.
- (iii) The parameter that are include in the model, are ^{liability} older liability, income, purchase sales statement, ^{asset} ^{loss}, Interest rate and etc....

- (iv) Accordingly, simulation language will be more preferable as a result, we can come to more accurate & precise results.
- (v) We should include the experts of real world, so that they can guide us to development of a well working model.
- (vi) Then perform the model script or run the programme, also note the per view along side.
- (vii) Then check that we are getting a output in worst situation i.e., the probability of default is more than 0.5%.
- (viii) Then check that by changing the Interest rate, Inflation & etc. parameter, we are getting the desirable output or not.
- (ix) Also verify that your model follow all the professional guidance.
- (x) Communicate the result, that the prepared model, is used to estimate the company capital at worst scenario. i.e., bankruptcy / hyperinflation.

- ② An insurance company has a block of in-force business under which policyholders have been given option & investment related guarantees.

A stochastic model has been developed which project option & 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 payout under the policies. A Board member has been asked whether there are any factor which could cause this probability of inaccurate.

Outline the item you would mention in the response.

Soln The factors that cause the probability to be inaccurate-

- The ratio of the project option & investment guarantee.
- The pricing method of the model
- Interest/Inflation rate
- Number of policies sold.
- Amount of the premium received.
- Number of claim incurred.
- Risk in the investment Project.
- Unit linked payment.

- 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.

Soln

- (i) Objective of the model to determine the future mortality of the small country.
 - (ii) We can take the data for the model from the hospitals, governments bodies, funeral places, Insurance companies.
 - (iii) We can take parameters for this model like age, gender, past mortality rate, health policy,
 - (iv) Then go for checking & verification of the data, for eg. check if there any missing value, is there the error of the double count.
 - (v) Then go for the cleaning of the data, (i.e) removing of the double entries, missing value eradication & etc..
 - (vi) Then transform the data in which it can be used for the model, i.e in descriptive, inferential, predictive, big, etc..
 - (vii) Model the data & then communicate the result with the assumption of interest rate & the pop^m rate are constant.
- Finalise the model after the checking done by the experts.

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

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

Soln

- The frequency of the data.
- Source of data.
- Step by step of the model (Peer's view).
- Assumptions.
- Parameters.
- Type of the model (eg: proxy, Worst Case, Scenario base).
- If there are any limitation or validity of the model.

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 projection 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 next 20 years.
- Apply the forecast age-specific consumption rates to the projected population by age to obtain estimate total consumption of the product by age for each of the next 20 years.
- Sum the result to obtain the total demand for each year.

Describe the advantage & disadvantage of this strategy.

Soln

Advantages of the Model :-

- The model is easy to Interpret & Communication
- Past 10 years data of the consumption is almost sure as it was successful.
- Since we have the data for the next twenty years it becomes easy for the development.

- An actuary can use the assumption of the first model too.
- * Disadvantage of the Model -
 - Competitive launching new model
 - Past trends of the consumption by age might not be best guide
 - There may be chance that everybody has not bought the old policy.
 - There might be chance that there is the change in mortality rate, health of the people & etc...

- ⑥ Following a review of the result of a stochastic model run, an actuary request that a parameter is changed. The change is not expected to alter the results signify. But result on final basis are required in order to complete a report. Unfortunately the actuarial student who produce the original model run is away on study leave, & so the revised run is assigned to different student.

When the revised result are produced they are significant differently from the original result.

Discuss possible reason why result are different.

Solⁿ

- There may be chance that method of approaching to result for both the student might be different, so there is the different Answer.
- Both of them might have different set of assumption.
- May be they have use different type of data: eg one has use predictive data & other may opt for the inferential data.
- There might be reason the first student hasn't perform the peer review so there is the chance of different mistake in the other's model development.
- Human Error's.
- There might be change that older one with a experience & new one will be fresher.

- ⑦ A new town is planned in a country rural Area. A model is to be developed to recommend the number & size of school required in new town. The proposed model approach is as follow.

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 & mortality rates by age used to estimate birth & rates.

The birth & deaths are applied to the initial population distribution to generate a project distribution of the town population by age for each future year, & hence the number of school age children.

Discuss the appropriateness of the proposed modelling approach.

Soln

→ The appropriateness of the proposed model approach :-

- (i) For the appropriateness of the proposed model, we should put highlight on the objective i.e. Number of size of school in the new town.
- (ii) We should go for the validity check of the objective & should highlight the purpose of model.
- (iii) Then we should check the distribution population, probability & other ^{that} ~~solution~~ are giving the true/required output or not.

- (iv) The possible error might be the planned probability may go wrong, the pandemic/ ~~can~~ ^{unknown} the new disease may change their mortality changes, & also population deviate, also depends on the specific geographical area. this are some factors which intrudes to model & doesn't need real-world reputation. so we could also go for Turing test
- (v) We should find the correlation btwn the parameter which are used in the model as a result there should also be correlation in the output. we should prefer ~~the~~ a small sample size to model with the assumption which we have mentioned to find correlation with the real world.
- (vi) We should check the source of data are ^{from} official & legal bodies, we have to check to its credible & reliable.
- (vii) We shouldn't overprecised so that we can't the variable & hence the output to be flexible with the model.
- (viii) Then we should communicate the result in as simple as so it's easy to understand
- (ix) Then we should comply all regulatory & legal requirements, that should be apply legally in the firm.

- ④ A large ~~company~~ company wishes to construct a sickness rates among its employee to use in evaluating the present & future financial health of its sick pay scheme. Outline factors which the company should take into consideration when developing the model.

Solⁿ

- Since the company has nature of existing data, it will only tends to the complex model.
- Whether the company has any previous data about the same or not, it will help us to find the complexity of the model, i.e. the model should be stochastic or deterministic.
- It should also collect the data from the hospital, the weather forecast sample in the same locality.
- General trends in health & Benefit under the scheme
- Any disease which is already there in employee before the scheme.
- No. of employee, premium etc....
- ~~Is there~~ Is the Insurance plan has the quantum share Insurance etc. full is paid by them.

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