

Assignment 1.

Ans 1) 1) Develop a well-defined set of objectives that need to be met by the modelling process.

- Objective:- Capital held should follow regulatory requirements i.e there should be less than 0.5% chance of liabilities exceeding assets. Thus, building a cash flow projection model that exhibits 99.5% probability that assets exceed liabilities.

2) Defining the scope of the model.

- Assuming The scope of the model is built around the scenario of negative interest rate
- The factors taken into consideration shall be the short-term & long term assets & investments held by the company; the type of investments, inflation rate etc.
- The impact of negative interest rate

on these various factoring affecting assets and liabilities.

3) Planning the development of the model including how the model will be tested and validated

- o Generally the insurance company has investment in interest sensitive assets & market interest rate sensitive products for customers (ULIP products), thus a negative interest rate could affect their profitability.

- o Although Negative interest rates could make insurance products less appealing and ruin their equity profile

- o We can build a model around the various types of assets (investments) and liabilities and perform simulations and sensitivity testing to understand & work out a way to fulfill regulatory requirement under each scenario.

4) Consider alternative forms of model, decide & document the chosen approach.

- It involves considering the central bank & economy's reaction to negative interest rate to find the appropriate products to invest in to meet the liabilities.

- This can be evaluated using scenario based modelling & sensitivity testing.

5) Collecting the data required.

- This involves collecting historic internal/own data, policy data, investment performance etc.

6) Choosing parameters

- We can choose parameters like discount rate, inflation, expenses, claim settlement etc.

7) Existing "worst case scenarios".

- This would include recession, deflation, black swan events etc.

~~Ans 2) The various factors affecting probability of payout under the policy is:~~

8) Choosing software, write & debug the computer program.

9) Testing the reasonableness of the output using statistical inferences and methods such as "Turing test".

10) Testing the sensitivity under various scenarios.

11) Calculate the overall capital structure.

12) Communicating the results to board of directors.

Ans 2) The factors affecting probability of payout under the insurance policy:-

- ① The implication of guarantees and options for asset and liability valuation and product pricing
- ② The certainty provided to the policyholder comes at a cost that may or may not be transferable
- ③ ~~The existing investment~~
- ③ Whether the portfolio is static replicating portfolio or a dynamic hedge portfolio

- ④ The assumptions made & range of possible values considered.
- ⑤ Asset combinations available in the market to find derivative options that fulfill the pricing & payout objectives.
- ⑥ Inflation rates & their impact on the products & derivatives.

Ans 3) The stages to go through while identifying an appropriate model are:-

- ① The major objective is to forecast the mortality of the country, keeping in mind the various parameters such as population distribution, demographic features, life expectancy as per past records, frequency of natural calamities, environmental factors such as pollution etc.
- ② The model can use historical data and use that to apply statistical inferences and methods. We can also use stochastic modelling to determine future probability.
- ③ The historical data of the government resources, insurance companies, regulator etc. should be valid & credible to give correct range of outputs.

④ The impact & extent of correlations between the various parameters must be taken care of as their dependency affects the results of the model

~~⑤ The errors — as~~

⑤ The assumptions should be reasonable & specific to the relevance of the current values of the parameters

⑥ The ease of the model (it should not be a black box) & thus must be easy to communicate to the various stakeholders

Ans 4) The documents required for are:-
document

① The original data and computer code that is documented at each stage to describe and justify every decision taken and assumption made

② The methodologies used, parameters taken into consideration, data used, should be provided to make documentation more clear & easier to understand at every step.

③ One can include the summary of the results along with visual representation to ensure understanding of the model

to non-actuarial stakeholders.

- ④ Statistical programming tools like R-markdown ~~entire~~ helps in explanation of code in a simple manner. Thus it helps in maintaining a fully documented code.
- ⑤ Proper documentation ~~make~~ improves transparency, makes audit control easier and makes reproducibility easier.

Ans 5) Advantages:-

- 1) The data being used is the company's own historical ~~over~~ data, thus it is fairly valid.
- 2) The data is already available, thus cost & effort required to collect data from others is saved. Moreover that data may not be credible as it is not product-specific.
- 3) It has taken into account the age-specific targetted audience which is useful to make statistical inferences.

Disadvantages:-

- 1) Trend analysis may not necessarily be true for the future. Eg:- Introduction of a new similar competitive product could majorly affect the demand & supply of the product.

- 2) The demand for the product may decrease & eventually subside in the upcoming years.
- 3) It does not account for factors other than age.

Ans 6) Following could be the reasons:-

- ① There was lack of documentation owing to which the assumptions & methodologies used by the first student were ~~not~~ not known to the second student. Thus the difference of approach caused the difference in outputs.
- ② The expected change differed from the actual change owing to interdependence of the various parameters which was taken into consideration while estimation but was reflected in the model run. Thus the sensitivity of the parameter was misjudged.

Ans 7) 1) They should consider uncertainty associated with mortality rates and fertility rates. For instance, pandemic owing to COVID-19 ~~at~~ ~~in~~ could affect these values.

- 2) The data is valid and credible enough to draw meaningful statistical inferences
- 3) It should also take into account that certain children may be home-schooled
- 4) Current population distribution may change owing to migration
- 5) The model ~~it for~~ should be simple to perform & understand

Ans 2) Following factors can be considered & evaluated by taking a survey for all the employees:-

- ① The average age of the employees to understand the general lifestyle and risk of diseases associated with their age.
- ② The gender distribution i.e. no. of males & no. of females.
- ③ The locality in which they live. Eg: If they live near industrial area, they are susceptible to lung diseases.
- ④ The drinking & smoking habits
- ⑤ Underlying/pre-existing diseases & medical history.
- ⑥ Insurance coverage bought
- ⑦ The average amount spent on medicines

\$ hospitalisation to aid pricing for the
sick pay scheme.