

Semester 2

Subject: Introduction to Actuarial Models

Assignment 1

1. The steps involved in a modelling process are:

- Develop a well-defined set of objectives that need to be met by the modelling process: Any model must have a well-defined set of objectives to measure the outcomes against, for example we may want a model that looks at insurance policies be accurate for 95% of the policies.
- Plan the modelling process and how the model will be validated: The steps and the algorithm to follow must be outlined before starting the modelling process, furthermore, the model must have diagnostic tests in place to test the outcomes and check if they meet our objectives or not.
- Collect and analyse the necessary data for the model: One must ensure that appropriate data is required for the model and ensure its sanctity to rule out any discrepancies in its outcome.
- Define parameters for the model and consider appropriate values for the same
- Define the model initially to mirror a real-world scenario
- Get feedback from experts on the validity of the initial model
- Describe whether a simulation package or a general-purpose language is appropriate for the model.
- Based on the decisions taken, write a computer program to run the model. This would make it easier to deal with larger datasets and account for changes in data later.
- Debug the program to ensure that it is running properly without any issues.
- Test the reasonableness of the output of the program.
- Vary the input parameters and check for the variation in the final output. This kind of sensitivity analysis helps rule out any discrepancy in the model.
- Analyse the output from the model.
- Ensure that any regulatory and professional guidelines have been adhered to.
- Communicate and document the results after running the model.

2. The factors that could cause the probability to be inaccurate are:

- The data that has been fed in may be inaccurate, which would lead to discrepancies in the result.
- The model may be sensitive to one or more inputs, and a change in value of one may lead to a significant change in the overall output.
- The data collected may not have been sampled appropriately and have a bias.
- As it is a stochastic model, the output is only a snapshot or an estimate of the characteristics of the model for a given set of inputs.
- The model may not have passed tests of validity and verification.

3. The steps I would take in identifying an appropriate model are:

- Set out the key objectives that the model must accomplish.
- Determine the type of model that would be appropriate.
- Determine the validity of the model to test for mortality rates.
- Consider the validity of the data to be used in the modelling process.
- Consider the validity of assumptions that I would use to model the mortality.
- Consider the impact of correlations between the random variables that drive the model such as age and sex.
- Check the relevance of models made and used in the past to determine the mortality of the country.
- Check the credibility of the data source and cancel out any kind of biases that may have arisen due to bad data.
- Consider the ease with which the results of the model can be communicated to the government.
- Consider the implications that a spuriously accurate result can have.
- Check its sensitivity to change in factors such as age, living conditions etc.
- Ensure that the model adheres to any regulatory requirements that the government may have and have set out.

4. The main objective of technical documentation is to minimize key person dependency for the model users/owners and to allow any reasonably competent modeler (including a new one) to understand its methodology. Comprehensive documentation should contain sections on model inputs, calculations, outputs, limitations, associated business processes, governance practices, application, and platform specifics. The key items that I would include in my model documentation are:

- The inputs, all the data, assumptions and parameters considered while building the model.
- Any special considerations take before running the model.
- The intermediate calculations and methodologies used to do the calculations.
- The final output, the interim calculated values, and the final output
- Results of verification and sensitivity testing.

5. Advantages:

- The data is segregated into strata (age), this would help give a clearer picture about the demand in the future and account for anomalies which would have risen because of normal random sampling.
- As sampling done is stratified, a smaller sample size would be enough to give a precise result.
- Population forecast is being taken into consideration; hence the results will be more accurate.

Disadvantages:

- Simple extrapolation may not match with actual rise/decline in demand for product over the next 20 years.
- Does not take into consideration shift in peoples tastes or changes in people's perception or eating habits in the future.
- The proposed model does not account for current trends in the market relying heavily on past data, this may result in the model not matching the actual demand and hence, over investment into the production capacity.

6. The reasons for this variation can be: -

- Improper Documentation: The model and its required parameters may not have been documented properly, this would mean that anyone other than the initial user that tries to run the model will have to figure out for themselves what the correct parameters and input are.
- Incorrect Inputs: The inputs put in by the new student might not be in line with what the model expected, or they may have changed multiple parameters or inputs which the actuary did not propose leading to this discrepancy.
- Ineffective model creation: The model created may be too complicated to understand and require specialised inputs that may not have been mentioned in the documentation.
- Lack of sensitivity testing and peer review: The model must not have been put through the rigors of sensitivity testing and peer review. As a result, the model may be increasingly sensitive to changes in certain parameters and the outputs not verified by credible sources.
- Discrepancy in data used: The data used might not have been checked/cleaned properly. Hence, there can be significant outliers in the data that can have a huge impact as and when the parameters are changed. Additionally, outliers may not have been accounted for while creation of the model.

7. This approach to the modelling process has flaws. It is considering the existing population distribution of that area; the area in question has not been developed yet and would not be a good indicator of how the population distribution would look in a new town. Building on this point, the model does not take into consideration immigration and emigration, this would greatly affect the estimates. Even though the planned population is being considered, the population of the new town can greatly vary from its plans. For example, the town may have to accommodate more people than planned and would fall short with regards to the number of schools that it needs to provide quality education to its citizens. Additionally, the mortality and fertility rates that are being considered are on a national level, even though this may be a good indicator, a better estimate would be obtained if state wise or local rates (from a nearby city) are used as these rates can vary greatly depending on the location, climate, and culture that people follow in a particular area.

8. The factors the company must consider are:

- Demographic of the company: Factors such as the age of people working, their sex, and their lifestyles will affect how healthy the employees remain on average.
- Locations in which it has business operations: This would affect the rate at which people fall sick as disease spread varies from place to place. Additionally, there may be diseases that are region specific. Mortality rates may also vary from region to region.
- Data Sources being used: The company must ensure that the data used for the model comes from credible sources or spend its own time and capital for data collection.
- The designation of employees: Care must be taken to account for the difference in the sick pay scheme structure between various employees. Higher ranking employees may get greater benefits and may also be older and hence more susceptible to diseases. Conversely, higher earning employees may have access to better health care and hence be less at risk. All of this must be taken into consideration as well.
- Working and living conditions of employees: Employees working in the office may be less prone to ill health when compared to employees working in factories or construction sites. Moreover, some employees may be living far away from their actual office location and hence will be prone to a separate set of diseases.