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Roll no. 69
Div- B
FYBSC

* Actuarial Models * (Assignment 1)

1. According to me, the steps that are to be taken in the developement of a model where I have to project the assets and liabilities of an insurer after a year requiring regulatory change in capital without any stochastic models, assuming 'worst case' scenarios are:

i) Define the scope of the model, including the validation of it and how it will be tested; eg. factors to be modelled stochastically

ii) Review regulatory guidance

iii) Plan the developement of the model, including how the model will be tested and validated

iv) Consider alternative forms of model, decide and properly document the chosen approach. Where appropriate, this may involve discussion with experts on the underlying stochastic processes.

v) Collect any necessary data, for eg. historical losses or policy data for predictive analysis.

vi) Choose parameters. For economic factors should be able to calibrate with the market data. With factors eg. expenses, claim distributions need to discuss with staff.

vii) Existing "worst case" scenarios to be discussed with the staff who have made estimates, especially to gauge views on probability of events occuring. Like in this case the prediction / probability of the liabilities exceeding assets is 0.5% or less; which indeed needs a sufficient capital.

viii) Discuss on the software to be used for the model, which would be convenient and suitable.

ix) Writing down the computer programs, review the parameters that have the greater effect on outputs.

x) Debug the program, for example by checking the model behaviour for expected simple, defined scenarios.

xi) Review reasonability of the output which may include: - median outcomes (how do these compare with business plans)

- probability assigned to worst case scenarios

xii) Test the sensitivity of the model to small changes in parameters.

xiii) Calculate the capital requirement.

xiv) Communicate findings to management and document every step.

2. If I was asked by the Board member whether there are any factors which could cause this probability to be inaccurate, I would mention the following:

i) Models will be chosen, wherein a reasonable explanation of underlying real world processes is given, but this may not turn out to be the case (Model error).

ii) The model may be very sensitive to parameters chosen, and the parameters are estimates because the true underlying parameters cannot be observed. (Parameter error).

iii) Sampling error may result from running insufficient simulations. (It should be possible to give a confidence interval for error that could result from this source.)

iv) The management actions assumed may not match what would happen in extreme circumstances.

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v) Policyholder behaviour, such as take up rates for options, may differ in practice.

vi) There may be future events, such as legislative changes which affect the interpretation of the policy conditions, which have not been anticipated in modelling.

vii) There may be errors in coding of the model. The model is likely to be complex and difficult to verify completely.

viii) The model relies on input data, which may be grouped rather than being able to run every policy. Any errors in the data could cause the output to be inaccurate.

3. The stages I would go through to identify an appropriate model for the forecasting of future mortality of a small country are:

i) My priority would be to clarify the purpose of the exercise; basically does the government want to forecast mortality rates? The period wanted for forecast (short or long term), etc.

ii) Consult the existing literature on models for forecasting mortality, and to speak to experts in this field of application. Consider using or adaption existing models which are employed in other countries.

iii) Establish what data is available (eg. on past mortality trends of the country, preferably with deaths classified by age and cause of death).

iv) On the basis of the data available, define the model we propose to use. If the data is simple and not detailed, then a complex model is not justified. Will a deterministic or stochastic model be appropriate in our case?

v) Identify a suitable computer software to implement the model, or, if none exists, write a bespoke program.

vi) ~~Identify~~ Debug the program or, if existing software is used, check that it performs the operations we intend it to do.

vii) Run the model and test the reasonableness of its output. Consider, for example, the forecast values of quantities such as the expectation of life at birth.

viii) Test the sensitivity of the results to changes in the input parameters.

ix) Analyse the output.

x) Write a report documenting the results of the model and communicate the results and the output to the government of the small country.

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i) The tests performed to validate the output of the model.

ii) The definition of input data.

iii) Any limitations of the model identified (eg. potential unreliability) (technical error or bias / manipulation of any kind).

iv) Basis on which the form of the model chosen (eg. deterministic or stochastic)

v) References to any research papers or discussions with appropriate experts or professionals.

vi) Summary of the model and its results through methods like documentation.

vii) The names and professional qualification.

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viii) Purpose or objectives of the model
ix) Assumptions underlying the model and reliability of the sources.
x) In what way can the model be adapted or extended.

Strategy

5. → The advantages of the model mentioned above are:
- The model is simple to understand and to communicate.
- The model takes account of one major source of variation in consumption rates, specifically age.
- This 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.

→ The disadvantages of the model are:
- 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, eg. whether there is a recession.
- Factors other than age may be important in determining consumption eg. expenditure on marketing or 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 amt. 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.
- Unforseen 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 model does not capture cohort effects.

~~Q6. After the stochastic model run, an actuary seo~~

Q6. After the stochastic model run, the revised results are significantly different from the original results, the reasons could be:
- According to me one or both of the runs (previous or the new one) may have been incorrectly interpreted as something else (parameter) for eg. the new trainee might have not followed the procedure correctly or may have used different assumptions.
- The difference between the two runs may not have only been the parameter change, for example the two runs may have used altered or random seeds, or the second run have had fewer simulations.
- Also, the case that the model's expectation was

not sensitive or merely affected to a particular assumption or parameter could have been incorrect.
- At the point of time when the original model was made, the scenario might have changed at present times, and with the data changing constantly (live) the results might have been altered.
- This could also be due to amendments in the data in scenarios like the occurance of a pandemic which led to a significant change in the parameters, assumptions, etc.

These are the possible reasons of why the result may have been different.

7. A model that is to be developed to recommend the number and size of schools required in the new town, with the suggested approach being to multiply the current age distribution of the population in the area to the planned population; the appropriateness of the model according to me is:

i) Benefits according to me by this approach is that the Systems with long time frames can be studied (especially by simulating models), stochastic elements of complex systems.

ii) The model may have its limitations but, it should be simple to apply.

iii) The data specified are likely to be validated i.e. available from reliable sources.

iv) Although it is possible that the starting point for the planned population may be wrong, unforseen events may take place such as a national epidemic or a global one, this may be once in a blue moon which changes the rates. Eg. the recent pandemic breakout of covid-19 has altered every rate, assumption in every possible way.

v) For someone who is not as professional as an actuary, i.e. for laymen, this model is quite straightforward to explain to planners or develop-ers.

vi) Rather than simply using the current rates, the current trends in fertility rates or follow the mortality rate and assume rates in case of a pandemic or outbreak. Mortality rates are likely to be significantly relative to uncertainity in projection, because usually the average mortality age would be part of such age group whose child mortality and fertility rates should be low.

vii) Current age distribution for the area may not be the same as the one in the new town as there may be immigrants as well as many may leave and some who may have intended to come back may not after settling in a new town. Hence, a survey right now would be altered later. Eg. Rural areas may have different distributions than urban areas.

ix) According to me, things to be considered should be the type of houses being built and how they are marketing - as in are they family houses or studios?

x) They can use the distribution of a similar existing town to compare or research. May also wish to consider whether national fertility rates are appropriate for a new town where mostly young families would live.

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Q8. The factors which the company should take into consideration while developing the model of sickness rates among its employees to use in evaluating the present and future financial health of its sick pay scheme are:

i) Since the employees of a large company depend are mostly youngsters especially interns and trainees, the average age group would be of near 30s.
People of nearby age groups can be asked to fill a survey of some recently acquired health issue which may not be present at the joining date.

ii) There is empirical evidence that recovery dates depend on the duration of sickness.

iii) The limit of a certain time example 6 months on sick pay may cause more durational changes / effects around this parameter.

iv) However, this would make the model more complicated to analyse and increase the volume of the data required to fit parameters reliably.

→ The office would have a lot of employees being a huge one, with this database the office would have its own data / internal data of employees' medical conditions except recent ones if not updates.

v) For individuals in employement mortality rates are likely to be low, and almost ignorable.
Because the probablity of some employee with sickness which may be severe or require regular leaves for checkups, might be very low to ~~be~~ get the job.