

DEFINING A POSTERIORI DISTRIBUTION OF AN ACTUARIAL VALUATION FORECASTING: A MIXED APPROACH

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ABSTRACT

COMPANY ABC wants to perform an early retirement program. Its aim is to use it as a rightsizing mechanism, applying it on a three year period. It has asked its Consulting Actuary to perform a 5-year estimate of what the expected obligations will be in such period should the program be applied. Due to budget and time issues an ALM approach is not feasible, neither is to perform a straight forward non-stochastic actuarial forecasting given the fact that the risk in which its Consulting Actuary could be involved once it provides its results could be large. The present paper presents a mixed approach set to avoid this problem. This mixed approach is set to define a posteriori statistical distribution for the valuation results that correspond to a particular year, by the means of producing many 5-year actuarial valuations in which each eligible participant under the program is set to retire or continue as active using Monte Carlo. Thus, instead of providing a sole figure, a range in which the possible outcome may fall and/or set of statistics related to the possible outcome of each valuation year can be provided². The present paper is divided in three parts. The first provides an overview of the normal and early retirement plan's definition and its related assumptions. The second explains the algorithm used. The third provides our view of what should be the next step.

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² A program to perform the valuations under this approach has already been developed under FoxPro.

COMPANY ABC: RETIREMENT AND EARLY RETIREMENT PLAN DEFINITIONS AND ASSUMPTIONS

COMPANY ABC, retirement plan provides benefits under the contingencies of disability (before retirement) and retirement after its employee has reached a condition defined in terms of an attained age plus years of service. Such condition requires the participant to attain an age such that once it is summed to his/her accrued years of service, it totals 75 if male or 70 if female. Years of service rendered to Government entities are taken into account. Nevertheless, participants must have a minimum of 15 years of service in order to gain the right to retire under the plan. As from this point, we shall define as “Normal Retirement Age” (NRA) the age at which the participant fulfills the plan’s conditions.

The condition under which a participant can apply for an Early Retirement, have been set as having at least 15 years of service and for the participant to require no more than 10 years to attain his/her normal retirement age.

Given the fact that the purpose for COMPANY ABC to put an early retirement program is for rightsizing, it will previously set a target of the amount of people it wishes to retire, expressed as a percentage of its population.

The demographic and financial assumptions used during the exercise were those used in the actuarial valuation as at December 31/2005.

For the application of Monte Carlo, the average and standard deviation of attained age plus accrued years of service of participants with more than fifteen years of service (disclosed by sex) was used in order to define the distribution, from which sample values are to be drawn. By allowing values from people with required future years of service greater than 10 years to participate, we shall expect a greater number of participants during the first year (which would be in line with previous experiences).

Finally, due to the fact that COMPANY ABC has stated that, unlike previous trials, posts will be closed after an employee has retired, that this exercise has been made under the assumption of a closed group.

THE ALGORITHM

In order to simplify the explanation we will divide the algorithm in 3 steps:

1. Setting the initial parameters;
2. Working with the different types of employee;
3. Modifying databases to get on to the next year.

Setting the initial parameters

Before a run can take place, we first need to set our target as well as to identify who are the participants who could retire under the early retirement program.

Let N^* be the total amount of participants under the plan.

We will first disclose N^* into three groups. These are:

- N^1 which comprises active participants not eligible under the plan;
- N^2 which comprises active participants eligible under the plan;
- N^3 which comprises inactive participants.

Our first parameter to be set will be our target λ which will be defined as a percentage of $(N^1 + N^2)$.

Then we shall define (σ_M, \bar{X}_M) and (σ_F, \bar{X}_F) which will be the standard deviation and mean of the variable $\beta_x = (\text{attained age}) + (\text{accrued years of service})$; of all male and female participants that are part from N^* with at least 15 years of service in COMPANY ABC. We will assume that β_x will be defined as a $N(\sigma_M, \bar{X}_M)$ or $N(\sigma_F, \bar{X}_F)$ if the participant is male or female (respectively).

Working with the different types of employee

As stated before, N^* was divided into three groups: N^1, N^2, N^3 . N^1 and N^3 will be calculated in a regular fashion, having into account that their obligations will be adjusted to the probability of being part of the group n-years later.

In the case of a participant that belongs to N^2 that we shall focus on.

Let x_i be a participant belonging to N^2 . This participant is eligible to the program so, he/she may opt to an early retirement. Let's assume that we are performing an actuarial valuation at year "m" and up to the previous valuation x_i has not retired. This participant (x_i) could have retired during the interim, so by the use of Monte Carlo we determine if this has been the case, bearing in mind that should this happen, actuarial valuations corresponding to subsequent years will consider him/her as a retiree (forming of a new status "Employee retired under the program").

In order to determine if x_i has retired, we proceed as follows:

- Calculate β_{x_i} (β_x with x_i 's characteristics);
- Generate a random number from $N(\sigma_M, \bar{X}_M)$ if male or $N(\sigma_F, \bar{X}_F)$ if female;
- If β_{x_i} is greater than the random number, x_i continues as an active participant, otherwise it is assumed that he/she has retired during the previous year.

Another way x_i is considered to have retired during the interim is in the case that his/her attained age is greater than his/her NRA.

During the third year, if the target has not been reached, participants belonging to N^2 will retire in an orderly fashion until the target is reached or all members of N^2 have retired (in lieu of the conditions set by COMPANY ABC, that retirement will be mandatory to participants that continue as active during the last year of the program until such condition is met).

Modifying databases to get on to the next year

As from the second year, databases are modified in according to the following criteria:

- Salaries and pensions are increased in terms of the plan's conditions and the actuarial assumptions being used;
- The above items are also adjusted in terms of the probability of survivorship (if retiree) or remaining in the group (if active);
- Attained ages, accrued years of service, future years of service are adjusted in terms of the accrual of an extra year of service.

With the above adjustments, we can proceed to calculate the actuarial obligations in accordance with the steps described above.

NEXT STEP

Should the present procedure gains the approval of the actuarial community, seen as a means to broaden the scope of services that could be provided to a client with an early retirement program, I would suggest to consider as a next step to allow the forecasting module to generate forecasts allowing the introduction of “breakpoints” within the retirement benefit.