

## Summary 1

### PROJECT L3: CALCULATION OF LIFE INSURANCE PREMIUMS

#### Overall Purpose:-

Calculation of pure net premiums for a 10 year term assurance, whole life contract and a possible option benefit to take out further whole life cover without evidence of health.

#### APPROACH AND ASSUMPTIONS

##### Scenario 1 – Standard Premium Rates

Using  $\{l_x\}$  data from AM92 Ult, mortality rates  $\{q_x\}$  were derived for each age  $x$  from 50 upwards.

These mortality rates were used to calculate the required annuity and assurance functions, using recursion formulae. As instructed, premiums were assumed to be payable annually in advance and claims paid at the end of the year of death.

This was done both for a whole of life contract and a 10 year term assurance contract.

The method used allows flexibility to alter the mortality rate needed in the later scenarios.

The calculations were first performed at an interest rate of 4.0% p.a. and the results compared against the AM92 Ult Tables in order to check the accuracy of the formulae. They were then calculated again at 4.25% p.a. as required.

From these factors, the theoretical pure net premium rates were calculated as the assurance factor divided by the annuity factor.

##### Scenario 2 – Impaired Mortality

The calculations were then repeated for the whole of life product, but with the  $\{q_x\}$  rates multiplied by a factor of 2 to represent mortality impairment.

Again, the method used allows flexibility to alter the mortality rating for subsequent calculations.

The premium rates were reasonableness checked by noting that basic mortality rates roughly double with an addition of six years to the age, and hence premium rates for an impaired life aged  $x$  should be similar to premium rates for an unimpaired life aged  $x+6$ . It was also checked that a rating factor of 1 gave the same results as under Scenario 1.

## Summary 2

### APPROACH AND ASSUMPTIONS contd

#### Scenario 3 - Option Premiums

In calculating the option premiums the instructions regarding mortality assumptions have been followed. I.e. it has been assumed that all lives experience mortality following the AM92 Ult table for the first ten years, and that after that time the lives that exercise the option will suffer mortality twice that of AM92 Ult and those that do not exercise the option will continue to follow AM92 Ult.

The value of the option was calculated using:

Present value of option =

Present value of total benefits – Present value of total standard premiums

The option premium payable for the first ten years is then the present value of the option divided by the present value of a premium of 1 p.a. payable for ten years.

The option premium was reasonableness checked at a very high level by ensuring that its ratio to the standard premium was considerably less than 100% and that this ratio reduced with age (as fewer policyholders are expected to survive to the option exercise date). It was further checked by setting the take up rate to zero, and assuming nil impairment to mortality, each giving a nil option premium.

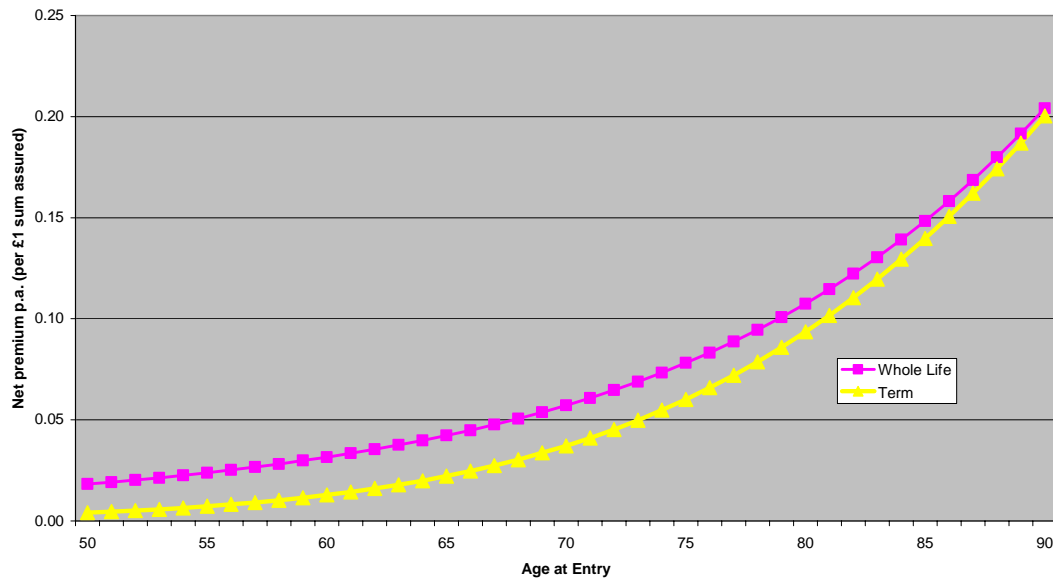
#### Summary of Assumptions

- Policyholders are exact age  $x$  on entry.
- Premiums are payable annually in advance and benefits are paid at the end of the year of death.
- Expenses, tax, lapses, profit margins and the cost of holding supervisory reserves can be ignored.
- All lives experience AM92 Ult mortality for the first ten years. After the option date, this remains true for those that did not exercise the option, but those that did exercise the option experience mortality twice that of AM92 ultimate.
- “Standard premium rates” for the basic benefits thus do not make any allowance for the higher potential mortality of part of the population.

### Summary 3

#### SCENARIO 1 – STANDARD PREMIUM RATES

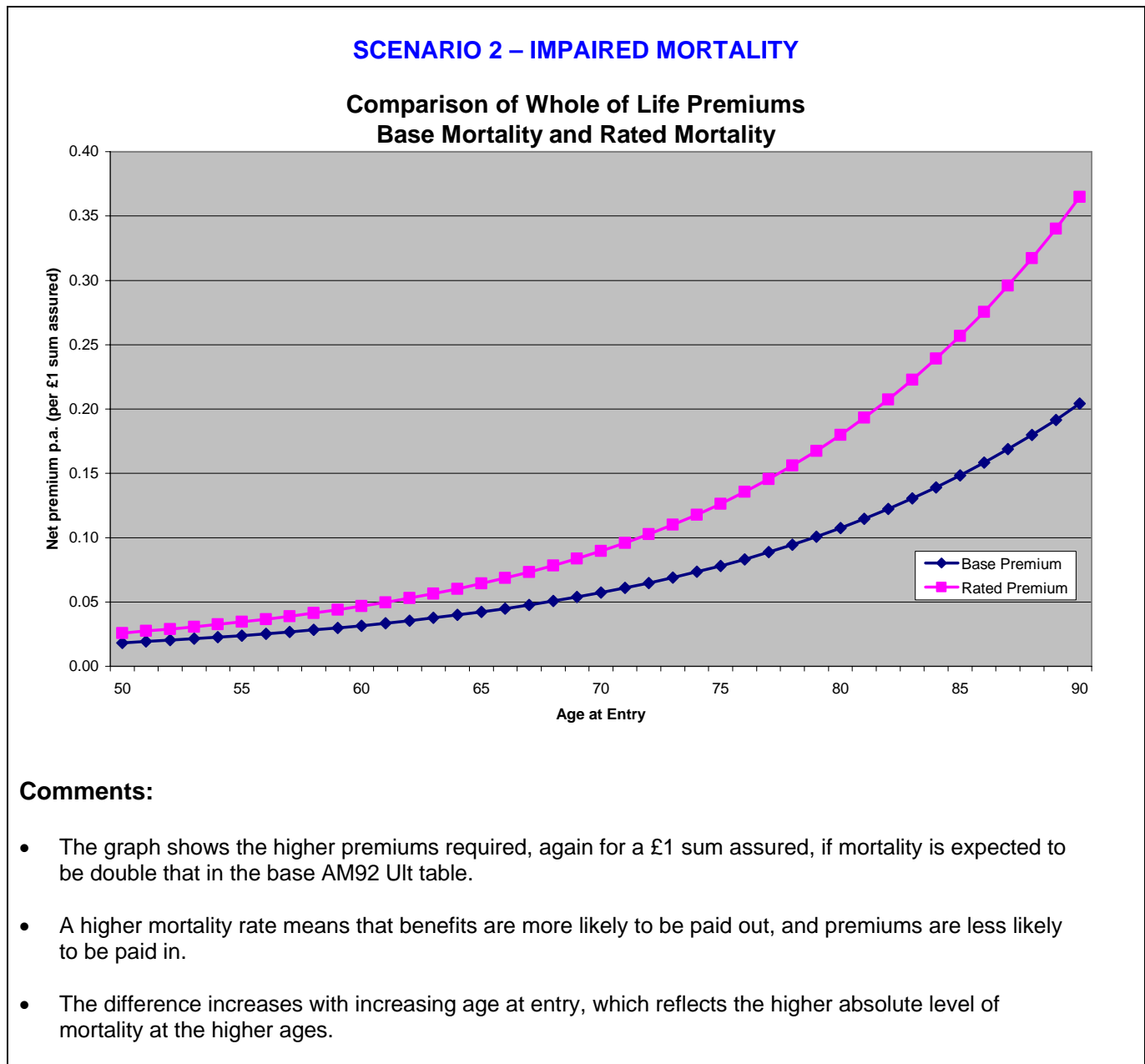
Comparison of Whole of Life and 10 year Term Assurance net premiums



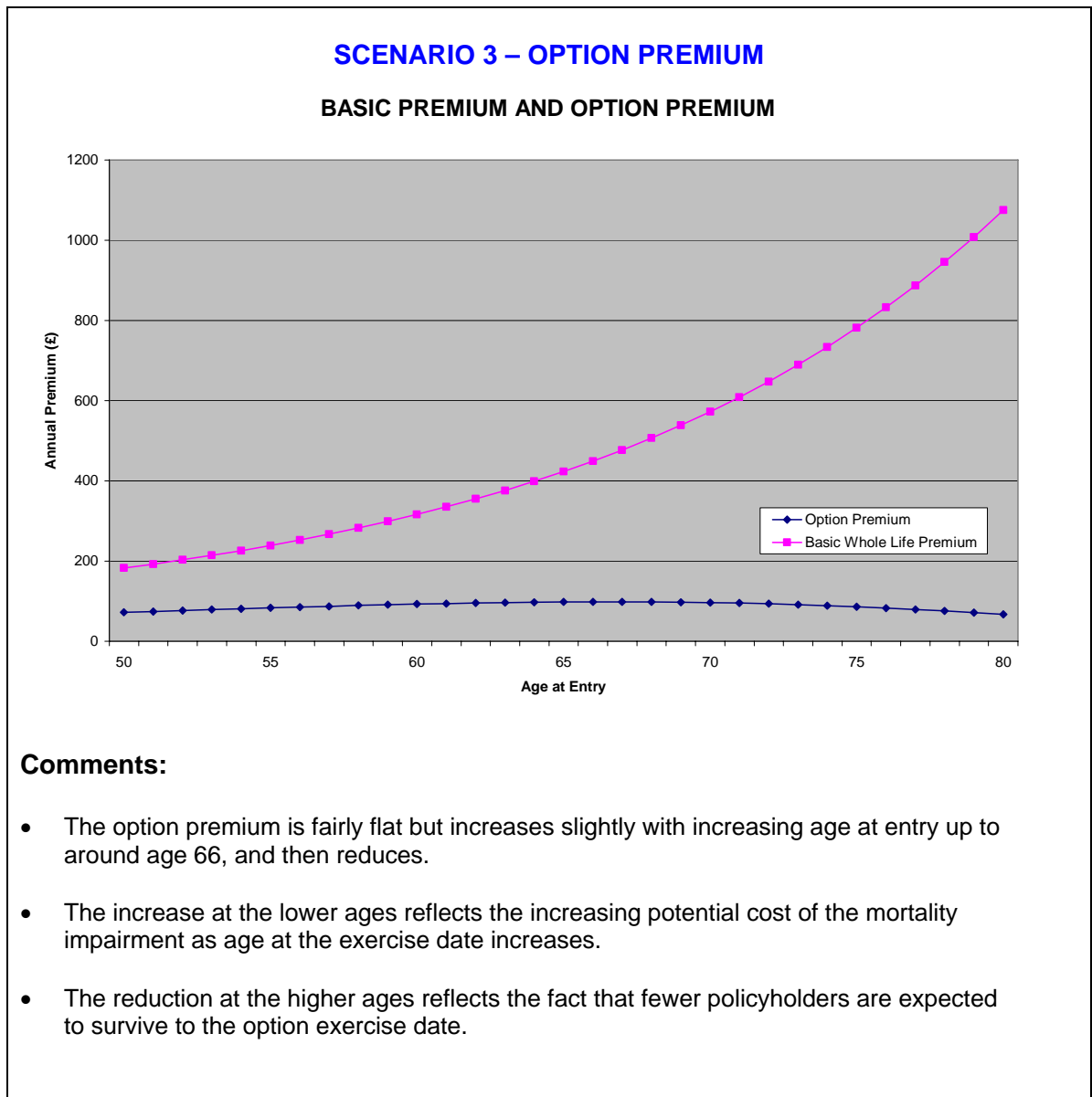
**Comments:**

- The chart shows premium rates for the term assurance and whole of life product for a £1 sum assured. The premiums increase smoothly for each product.
- The premium rates for whole of life are higher than for term assurance, as would be expected since the former guarantees payment whilst the latter does not.
- However, the difference reduces with increasing age at entry. This is because as people age they are more likely to die within ten years, and so receive a payout from the term assurance.

## Summary 4



## Summary 5



## Summary 6

### SUGGESTED NEXT STEPS

**Possible next steps are:**

- Allow for select mortality at policy issue
- Allow for expenses, commissions, solvency margins etc
- Sensitivity test the option take-up rates
- Sensitivity test the rating used for lives exercising the option
- Test the option cost if it is exercised at 5 years or 15 years instead
- Consider an American style option (exercisable at any point before expiry), rather than a European option (exercisable only at expiry)
- The actuary should also consider the marketability of the proposed option:
  - Are policyholders willing to pay additional premiums at this level for the benefit of the option?
  - Do other companies offer something similar?
  - Would it be more attractive to older policyholders if the exercise date was the fifth anniversary?