



INSTITUTE OF ACTUARIAL  
& QUANTITATIVE STUDIES

**Subject:** Pricing & Reserving  
for Life Insurance  
Products

**Chapter:** Unit 1

**Category:** Practice  
Questions

**1. CT5 September 2012 Q4**

Calculate  ${}_3p_{55.75}$  using the assumption of Uniform Distribution of Deaths.

Basis:

Mortality ELT15 (Females)

**2. CT5 September 2013 Q18**

Show, using the random variable approach, that the expected present value of an annuity of 1 per annum payable annually in arrears to a life now aged  $x$ , deferred for  $n$  years is equal to  $a_x - a_{x:\overline{n}|}$ .

**3. CT5 April 2013 Q10**

A special whole life assurance policy issued to a life aged 40 exact provides a benefit of £1,000 on death within 20 years of inception, £2,000 on death between 20 and 40 years from inception and £3,000 on death thereafter. Benefits are payable at the end of the year of death.

Calculate the expected present value and variance of the present value of this policy.

Basis:

Mortality AM92 Ultimate

Interest 4% per annum

**4. CT5 September 2014 Q7**

A life aged 40 exact purchases an endowment assurance policy whereby the sum assured on survival at age 60 exact is £20,000 and the benefit payable on death during the term is £10,000. Death benefits are payable at the end of the year of death.

Calculate the expected present value and variance of the benefits under this policy.

Basis: Mortality AM92 Select

Interest 4% per annum

Expenses Ignore

**5. CT5 September 2014 Q8**

- (i) In the context of random variables define  $T_x$  and  $K_x$ .
- (ii) State the random variable for the following expected values:
- (a)  $\bar{A}_x$
- (b)  $a_x$
- (c)  $A_{[x]:\overline{n}|}$
- (d)  $5 | \ddot{a}_x$

**6. CT5 April 2016 Q1**

Calculate  $0.5 p_{90.25}$  using the method of Uniform Distribution of Deaths. Show all your workings.

Basis:

Mortality ELT15 (Males)

**7. CT5 April 2016 Q6**

- (i) Prove that  $\bar{A}_{x:\overline{n}|} = 1 - \delta \bar{a}_{x:\overline{n}|}$  for the following basis.

Basis:

Force of mortality  $\mu_x$  is constant for all  $x$

Force of interest  $\delta$  throughout

An endowment assurance pays a sum assured of 10,000 immediately on death or on survival to the end of the term of the policy.

- (ii) Calculate, showing all your workings, the premium payable continuously for a life aged 40 exact for an endowment assurance with a term of 20 years.

Basis:

Mortality  $\mu_x = 0.01$  for all  $x$

Rate of interest 5% per annum

**8. CT5 September 2016 Q1**

A whole life assurance policy provides a benefit of 100,000 payable immediately on the death of a male life who is now aged 45 exact.

Calculate, showing all your workings:

- (a) the expected present value of this policy.
- (b) the variance of the value of this policy.

Basis:

Mortality AM92 Ultimate

Rate of interest 4% per annum

**9. CT5 September 2016 Q4**

Calculate, showing all your workings:

- (a)  ${}_{10|5}q_{65}$

- (b)  $\ddot{a}_{[30]:\overline{15}|}^{(12)}$

Basis:

Mortality AM92

Rate of interest 4% per annum

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**10. CT5 September 2016 Q6**

- (i) Show, using the method of Uniform Distribution of Deaths, that:

$${}_{2.5}q_{80.75} = \frac{10}{117}$$

- (ii) Calculate, showing all your workings,  $\ddot{a}_{80:\overline{4}|}$

Basis:

Mortality  $lx = 110 - x$  for all  $x$

Rate of interest 5% per annum

**11. CT5 April 2017 Q1**

Calculate  ${}_{2.75}p_{77.4}$  assuming a Uniform Distribution of Deaths.

Basis:

Mortality PMA92C20

**12. CT5 April 2017 Q3**

Calculate:

- (a)  ${}_{12}p_{73}$   
 (b)  ${}_{10|}a_{56}$   
 ©  $A_{64:\overline{10}|}$

Basis:

Mortality AM92

Rate of interest 4% per annum

**13. CT5 September 2017 Q3**

Calculate  ${}_{2.25}q_{85.5}$  using the method of Uniform Distribution of Deaths.

Basis: ELT15 (Males)

**14. CT5 September 2017 Q6**

- (i) Calculate  $\ddot{a}_{40:\overline{4}|}$   
 (ii) Derive the value of  $A_{40:\overline{4}|}^1$  using your result from part (i).

Basis:

Interest 5% per annum

From the following life table extract

| $x$ | $l_x$   |
|-----|---------|
| 40  | 100,000 |
| 41  | 99,200  |
| 42  | 98,100  |
| 43  | 96,700  |
| 44  | 94,700  |

**15. CT5 September 2017 Q9**

A special whole life assurance policy is issued on a life aged 50 exact.

Under this policy the sum assured, payable at the end of the year of death, is 1 unit for the first 10 years decreasing to 0.75 units thereafter.

- (i) Calculate the expected present value of the benefit.
- (ii) Determine the variance of the present value of the benefit.

Basis:

Mortality AM92 Ultimate

Interest 4% per annum

**16. CT5 September 2018 Q5**

A two-year term assurance policy is issued to a life aged  $x$ . Under this policy an immediate payment of 100,000 is made if death occurs in the first year, rising to 150,000 if death occurs in the second year.

Calculate the expected present value of this policy.

Basis:

Mortality  $p_x = 0.99$  and  $p_{x+1} = 0.975$

The force of mortality can be assumed to be constant over each year of age

Force of Interest 5%

**17. CT5 September 2018 Q7**

Calculate  $\underline{A}_{70.75}$  assuming a constant force of mortality between ages 70 and 71 only.

Basis:

Mortality PMA92C20

Rate of Interest 4% per annum

**18. CT5 September 2018 Q3**

A life insurance company sells a special immediate annuity policy to a life aged 65 exact. The policy provides an annuity of 30,000 a year payable monthly in advance. Payment is guaranteed for the first five years and thereafter ceases immediately on the death of the policyholder.

Calculate the expected present value of this annuity.

Basis:

Mortality PFA92C20

Rate of Interest 4% per annum

Expenses Ignore

**19. CM1A April 2019 Q3**

Describe the main features of an endowment assurance contract.

**20. CM1A September 2020 Q2**

Calculate, using standard approximations where necessary:

(a)  ${}_{10|4}q_{[36]}$

(b)  $\bar{A}_{46:\overline{25}|}^1$

Basis

Mortality: AM92

Interest rate: 4% per annum

[Note: You should show your working, but intermediate steps can be shown using numerical values – no additional notation is required.]

**21. CM1A April 2021 Q5**

The force of mortality,  $\mu_x^*$ , experienced by a particular population at all ages  $x$  (where  $x$  is not necessarily an integer) is 20% higher than that under the PMA92C20 table.

Calculate the following, based on  $\mu_x^*$ , assuming a rate of interest of 7% p.a.

(i)  $\ddot{a}_{70:\overline{3}|}$

(ii)  $A_{70:\overline{3}|}$

**22. CM1A April 2021 Q6**

A special whole life assurance policy is issued to a life aged 45 exact. The policy provides a benefit of \$40,000 on death within 15 years of inception, and \$50,000 on death thereafter. Benefits are payable at the end of the year of death.

- (i) Calculate the expected present value of the benefit payments.
- (ii) Calculate the variance of the present value of the benefit payments.

Basis:

Mortality: AM92 Ultimate

Interest: 6% p.a.

**23. CM1A April 2022 Q4**

(a) Write down the formula for the variance of the present value of an  $n$ -year temporary annuity of £1 p.a. payable at the end of each year, issued to a life aged  $x$  exact.

(b) Calculate, showing all working, the variance of the present value of a 20-year temporary annuity of £5,000 p.a., payable at the end of each year, issued to a life aged 44 exact.

Basis:

Mortality AM92 Ultimate

Interest 4% p.a. effective



**24. CM1A September 2022 Q1**

Calculate, showing all working,  ${}_3.5q_{56.25}$ , assuming a constant force of mortality between integer ages.

Basis: Mortality ELT15 (females)



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