Manual for SOA Exam MLC.

Chapter 6. Benefit premiums.

Section 6.3. Benefits paid annually funded continuously.

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Benefits paid annually funded continuously

In this section, we will consider the continuous funding of insurance products paid at the end of the year of death.

Whole life insurance

Suppose that an insurance company funds a whole life insurance paid at the end of the year of the death at a continuous rate P while the individual is alive. The present value of the loss is

$$v^{K_x} - P\overline{a}_{\overline{T_x|}} = Z_x - P\overline{Y}_x.$$

The actuarial present value of the loss is

$$A_x - P\overline{a}_x.$$

If a whole life insurance is funded under the equivalence principle, then the annual benefit premium is

$$\overline{P}_x = \overline{P}(A_x) = \frac{A_x}{\overline{a}_x}.$$

If the funding is limited to t years, then the present value of the loss is

$$v^{K_x} - P\overline{a}_{\overline{\min(T_x,n)}|} = Z_x - P\overline{Y}_{x:\overline{t}|}.$$

The actuarial present value of the loss is

$$A_x - P\overline{a}_{x:\overline{t}|}.$$

The benefit premium which satisfies the equivalence principle is

$${}_t\overline{P}_x = {}_t\overline{P}(A_x) = \frac{A_x}{\overline{a}_{x:\overline{t}|}}.$$

n–year term insurance.

The present value of the loss for a n–year term insurance paid at the end of the year of the death funded continuously at rate P is

$$v^{K_x} I(K_x \le n) - P\overline{a}_{\overline{\min(T_x,n)}|} = Z^1_{x:\overline{n}|} - P\overline{Y}_{x:\overline{n}|}.$$

The actuarial present value of the loss for a n–year term insurance funded continuously at rate P is

$$A^1_{x:\overline{n}|} - P\overline{a}_{x:\overline{n}|}.$$

The benefit premium which satisfies the equivalence principle is

$$\overline{P}^1_{x:\overline{n}|} = \frac{A^1_{x:\overline{n}|}}{\overline{a}_{x:\overline{n}|}}.$$

If the funding is limited to t years, then the present value of the loss is

$$v^{K_x} I(K_x \le n) - P\overline{a}_{\overline{\min(T_x,n)}|} = Z^1_{x:\overline{n}|} - P\overline{Y}_{x:\overline{t}|}.$$

The actuarial present value of the loss is

$$A^1_{x:\overline{n}|} - P\overline{a}_{x:\overline{t}|}.$$

The benefit premium which satisfies the equivalence principle is

$${}_t\overline{P}^1_{x:\overline{n}|} = {}_t\overline{P}(A^1_{x:\overline{n}|}) = \frac{A^1_{x:\overline{n}|}}{\overline{a}_{x:\overline{t}|}}.$$

The present value of the loss for a n–year pure endowment funded continuously at rate P is

$$v^n I(K_x > n) - P\bar{a}_{\overline{\min(T_x,n)}|} = Z_{x:\overline{n}|}^{\ \ 1} - P\overline{Y}_{x:\overline{n}|}.$$

The actuarial present value of the loss for a n–year term insurance funded continuously at rate P is

$$A_{x:\overline{n}|}^{1} - P\bar{a}_{x:\overline{n}|}.$$

The benefit premium which satisfies the equivalence principle is

$$\overline{P}_{x:\overline{n}|}^{1} = \overline{P}(A_{x:\overline{n}|}^{1}) = \frac{A_{x:\overline{n}|}^{1}}{\bar{a}_{x:\overline{n}|}}.$$

If the funding is limited to t years, then the present value of the loss for a n–year pure endowment funded continuously at rate P is

$$v^n I(K_x > n) - P\overline{a}_{\overline{\min(T_x,t)}|} = Z_{x:\overline{n}|}^{\ \ 1} - P\overline{Y}_{x:\overline{t}|}.$$

The actuarial present value of the loss is

$$A_{x:\overline{n}|}^{\ \ 1} - P\overline{a}_{x:\overline{t}|}.$$

The benefit premium which satisfies the equivalence principle is

$${}_t\overline{P}_{x:\overline{n}|}^{\ \ 1} = {}_t\overline{P}(A_{x:\overline{n}|}^{\ \ 1}) = \frac{A_{x:\overline{n}|}^{\ \ 1}}{\overline{a}_{x:\overline{t}|}}.$$

n–year endowment.

The present value of the loss for a n–year endowment paid at the end of the year of the death funded continuously at rate P is

$$v^{\min(n,K_x)} - P\overline{a}_{\overline{\min(T_x,n)|}} = Z_{x:\overline{n}|} - P\overline{Y}_{x:\overline{n}|}.$$

The actuarial present value of the loss for a n–year term insurance is

$$A_{x:\overline{n}|} - P\overline{a}_{x:\overline{n}|}.$$

The benefit premium which satisfies the equivalence principle is

$$\overline{P}_{x:\overline{n}|} = \overline{P}(A_{x:\overline{n}|}) = \frac{A_{x:\overline{n}|}}{\overline{a}_{x:\overline{n}|}}.$$

If the funding is limited to t years, then the present value of the loss for a n–year endowment paid at the end of the year of the death funded continuously at rate P is

$$v^{\min(n,K_x)} - P\bar{a}_{\overline{\min(T_x,t)}|} = Z_{x:\overline{n}|} - P\overline{Y}_{x:\overline{t}|}.$$

The actuarial present value of the loss is

$$A_{x:\overline{n}|} - P\bar{a}_{x:\overline{t}|}.$$

The benefit premium which satisfies the equivalence principle is

$${}_t\overline{P}_{x:\overline{n}|} = {}_t\overline{P}(A_{x:\overline{n}|}) = \frac{A_{x:\overline{n}|}}{\bar{a}_{x:\overline{t}|}}.$$

n–year deferred insurance.

The present value of the loss for a n–year deferred insurance paid at the end of the year of the death funded continuously at rate P is

$$v^{K_x} I(K_x > n) - P\bar{a}_{\overline{\min(T_x,n)}|} = {}_{n|}Z_x - P\overline{Y}_x.$$

The actuarial present value of the loss for a n–year deferred insurance is

$${}_{n|}A_x - P\bar{a}_x.$$

The benefit premium which satisfies the equivalence principle is

$$\overline{P}({}_{n|}A_x) = \frac{{}_{n|}A_x}{\bar{a}_x}.$$

If the funding is limited to t years, then the present value of the loss for a n–year deferred insurance paid at the end of the year of the death funded continuously at rate P is

$$v^{K_x} I(K_x > n) - P\bar{a}_{\overline{\min(T_x,t)}|} = {}_{n|}Z_x - P\overline{Y}_{x:\overline{t}|}.$$

The actuarial present value of the loss is

$${}_{n|}A_x - P\bar{a}_{x:\overline{t}|}.$$

The benefit premium which satisfies the equivalence principle is

$${}_t\overline{P}({}_{n|}A_x) = \frac{{}_{n|}A_x}{\bar{a}_{x:\overline{t}|}}.$$

