

Module 2 Section 6 Exercises:

The purpose of Numbers 1 through 10 is to verify the consistency of the formulas:

$$\ddot{a}_\sigma = \frac{1-A_\sigma}{d}, \bar{a}_\sigma = \frac{1-\bar{A}_\sigma}{\delta}, \text{ and } \ddot{a}_\sigma^{(m)} = \frac{1-A_\sigma^{(m)}}{d^{(m)}} \text{ for } \sigma = x, \sigma = x:\bar{n}|, \sigma = xy, \text{ and } \sigma = \overline{xy}.$$

In each of Numbers 1 through 10, there are two problems referenced. Review each referenced problem and note that the first is an insurance product on one of the above statuses σ , and the second is an annuity product on that same status using the same actuarial assumptions. We've previously determined the EPV's for these products in the sections in which the problems appear. Now you're to show that the above formulas hold for these EPV's. Note that there may be some round-off error.

1. Number 1 from Section 2 versus Number 1 from Section 4
2. Number 2(b) from Section 3 versus Number 2 from Section 5
3. Number 7(a) from Section 3 versus Number 9(a) from Section 5
4. Number 8 from Section 2 versus Number 6 from Section 4
5. Number 4(b) from Section 3 versus Number 4 from Section 5
6. Number 8(a) from Section 3 versus Number 11 from Section 5
7. Number 9 from Section 2 versus Number 10 from Section 4
8. Number 10 from Section 2 versus Number 11 from Section 4
9. Number 25(a) from Section 2 versus Number 20(a) from Section 4
10. Number 28(a) from Section 2 versus Number 22 from Section 4

11. Using your answer to Number 1 from Section 3 and $\delta = 0.1$, apply the appropriate formula at the top of this page to determine $\bar{a}_{x:\bar{n}|}$. Compare your answer to the answer to Number 1 from Section 5.

12. Note that the relationship between \ddot{a}_σ and A_σ does not hold for statuses other than those listed above. As an example, compare Number 4 from Section 2 to Number 3 from Section 4. Both are n -year deferred products and both use the same actuarial assumptions. Show that the EPV's do not satisfy $\ddot{a}_\sigma = \frac{1-A_\sigma}{d}$.

13. Using DML(90) mortality and $i = .05$, determine the actuarial present value of a life annuity due issued to (50) with annual payments of 1000.

14. Using ILT actuarial assumptions, determine ${}^2\ddot{a}_{35}$.

15. Using ILT actuarial assumption, determine the variance of the present value random variable for each of the discrete annuities due described:
- (a) whole life issued to (45), with annual payments of 500
 - (b) joint life issued to independent lives both age 50, with annual payments of 1000
16. Using ILT actuarial assumption, determine the variance of the present value random variable for a 20-year temporary life annuity due issued to (30) with annual payments of 2000.
17. Given $q_{75} = .02$, $q_{76} = .05$, and $d = 10\%$ determine the variance of the present value random variable for a 2-year temporary annuity immediate issued to (75) with the first year's payment equal to 15000 and the second year's payment equal to 20000.
18. Using CF($\mu = .03$, $\delta = .05$) actuarial assumption, determine the variance of the present value random variable for a whole life annuity due issued to (x) with annual payments of 1000.
19. Use ILT actuarial assumptions and the claims acceleration approach to approximate the expected present value of a whole life annuity due issued to (40) with monthly payments of 250.
20. Use ILT actuarial assumptions and the three-term Woolhouse formula to approximate the expected present value of a whole life insurance of 10000 issued to (30) with benefit paid at the end of the semiannual period of death.