

Data for Question 2

Actuarially equivalent annuities:

\$300 per month for life to annuitant, with no death benefit.

\$160 per month for life to annuitant, with 100% continuing to surviving spouse for life.

\$K per month for life to annuitant, with 50% continuing to surviving spouse for life.

Question 2

In what range is K?

- (A) Less than \$160
- (B) \$160 but less than \$180
- (C) \$180 but less than \$200
- (D) \$200 but less than \$220
- (E) \$220 or more

Data for Question 14

Annuity for Smith: \$10,000 payable each 12/31 after death of Brown.

Interest rate: 7% per year, compounded annually.

Probability of death at any age  $x$ : Based on  $l_x = 100 - x$ .

Ages as of 1/1/91:

Smith: 70.

Brown: 97.

Question 14

In what range is the present value of Smith's annuity as of 1/1/91?

- (A) Less than \$70,000
- (B) \$70,000 but less than \$71,500
- (C) \$71,500 but less than \$73,000
- (D) \$73,000 but less than \$74,500
- (E) \$74,500 or more

Data for Question 6 (3 points)

Form of annuity: Life annuity-due.

Amount of annuity: \$1,000 per month.

To whom payable: Smith, age 65.

In lieu of this annuity, Smith and Jones (age 63) elect an actuarially equivalent joint and survivor annuity-due providing:

- (i) P per month while both are alive.
- (ii) If Smith dies before Jones,  $P/2$  for Jones' remaining lifetime after Smith's death.
- (iii) If Jones dies before Smith, \$1,000 per month for Smith's remaining lifetime after Jones' death.

Given:

$$\ddot{a}_{65}^{(12)} = 11.5$$

$$\ddot{a}_{63}^{(12)} = 12.1$$

$$\ddot{a}_{65:63}^{(12)} = 9.0$$

Question 6

In what range is P?

- (A) Less than \$780
- (B) \$780 but less than \$810
- (C) \$810 but less than \$840
- (D) \$840 but less than \$870
- (E) \$870 or more

Data for Question 12 (5 points)

Consider the following actuarially equivalent annuities:

- (i) Joint and 50% survivor annuity paying \$100 per month, with reduction only on death of annuitant.
- (ii) Joint and 50% survivor annuity paying \$110 per month, with reduction on first death (annuitant or beneficiary).
- (iii) Joint and 50% survivor annuity paying  $P$  per month with reduction only on death of annuitant. After death of beneficiary, 110% of  $P$  is paid for remaining life of annuitant.

Question 12

In what range is  $P$ ?

- (A) Less than \$97.50
- (B) \$97.50 but less than \$98.00
- (C) \$98.00 but less than \$98.50
- (D) \$98.50 but less than \$99.00
- (E) \$99.00 or more

2004

Data for Question 19 (3 points)

Participant age on 1/1/2004: 65.

Joint annuitant age on 1/1/2004: 64.

Interest rate: 7%, compounded annually.

Joint annuity terms: Lifetime payments of \$10,000 annually with the first payment at 1/1/2004. Upon the first death of the participant or joint annuitant, the payment decreases to \$6,000 and this amount is payable until the second death.

Selected values:

$$1000q_{64} = 8.685 \quad a_{65:64} = 8.4129$$

$$1000q_{65} = 9.816 \quad a_{65} = 9.8207$$

Question 19

In what range is the present value of the annuity on 1/1/2004?

- (A) Less than \$95,000
- (B) \$95,000 but less than \$105,000
- (C) \$105,000 but less than \$115,000
- (D) \$115,000 but less than \$125,000
- (E) \$125,000 or more

Data for Question 4 (4 points)

The following annuities immediate are actuarially equivalent:

- I. Straight life annuity of \$100 payable to a life age 65
- II. \$90 payable during the joint life of two independent lives both age 65, reducing to \$54 on the first death
- III. \$70 payable during the joint life of two independent lives both age 65, reducing to P on the first death

Question 4

In what range is P?

- (A) Less than \$57
- (B) \$57 but less than \$59
- (C) \$59 but less than \$61
- (D) \$61 but less than \$63
- (E) \$63 or more

Data for Question 7 (4 points)

Smith and Jones are independent lives of the same age. They pay a single premium to purchase an annuity immediate of \$1,000, payable annually as long as at least one of them is alive.

Interest rate: 5%, compounded annually

$$l_x = Bc^{-x} \quad \text{for all } x > 0 \text{ with } c = 1.01$$

Question 7

In what range is the single premium?

- (A) Less than \$19,250
- (B) \$19,250 but less than \$19,750
- (C) \$19,750 but less than \$20,250
- (D) \$20,250 but less than \$20,750
- (E) \$20,750 or more

Data for Question 29 (3 points)

Smith and Jones are independent lives.

Smith (age 65) and Jones (age 64) pay \$100,000 for an annuity with the following payments:

- (1) Annual payments of  $X$  at the beginning of each year and ending on the first death.
- (2) Annual payments of  $(X - \$3,000)$  beginning at the end of the year of the first death and continuing for the lifetime of the survivor.

Interest rate: 7%, compounded annually.

Selected actuarial factors:

$$p_{64} = 0.991315$$

$$p_{65} = 0.990180$$

$$\ddot{a}_{65:64} = 9.1707$$

$$\ddot{a}_{65} = 10.8207$$

Question 29

In what range is  $X$ ?

- (A) Less than \$8,522
- (B) \$8,522 but less than \$8,622
- (C) \$8,622 but less than \$8,722
- (D) \$8,722 but less than \$8,822
- (E) \$8,822 or more



Data for Question 4 (3 points)

Smith (age 65) has a spouse (age 60) as of 1/1/2006.

Smith is scheduled to commence a life annuity of \$1,000 per month beginning on 1/1/2006.

Instead, Smith elects the actuarially equivalent benefit commencing 1/1/2006 described below:

X per month while both Smith and spouse are alive, plus

X per month to the spouse for life after Smith's death, plus

\$1,000 per month to Smith for life after the spouse's death.

Selected actuarial values:

$$\ddot{a}_{60}^{(12)} = 12.176$$

$$\ddot{a}_{65}^{(12)} = 10.194$$

$$\ddot{a}_{65:60}^{(12)} = 8.023$$

Question 4

In what range is X?

- (A) Less than \$650
- (B) \$650 but less than \$700
- (C) \$700 but less than \$750
- (D) \$750 but less than \$800
- (E) \$800 or more

Data for Question 10 (4 points)

$$s(x) = 1 - .005x - .00005x^2, \quad 0 \leq x \leq 100$$

$Y$  = the probability that all of three lives exactly ages 40, 45, and 50 on 1/1/2006 will die during the five-year period beginning on 1/1/2011.

Question 10

In what range is  $Y$ ?

- (A) Less than 0.00042
- (B) 0.00042 but less than 0.00047
- (C) 0.00047 but less than 0.00052
- (D) 0.00052 but less than 0.00057
- (E) 0.00057 or more

Data for Question 15 (4 points)

Smith (age 65) purchases a single premium annuity on 1/1/2006 that has the following provisions:

Payments	\$1,000 annually for Smith's life with the first payment on 12/31/2006.
Death benefit	A survivor annuity of \$1,000 per year will be shared by Smith's twin children (age 35 on 1/1/2006) beginning on the 12/31 following Smith's death. Payments are made only if both children are alive.

Selected actuarial values:

$$\begin{aligned}
 a_{35} &= 13.5119 \\
 a_{65} &= 8.7004 \\
 a_{35:35} &= 13.1360 \\
 a_{35:65} &= 8.6451 \\
 a_{\overline{35:35:65}} &= 13.8888
 \end{aligned}$$

Question 15

In what range is the single premium for this annuity?

- (A) Less than \$13,200
- (B) \$13,200 but less than \$13,400
- (C) \$13,400 but less than \$13,600
- (D) \$13,600 but less than \$13,800
- (E) \$13,800 or more

Data for Question 26 (3 points)

Interest rate: 5.0%, compounded annually

$$p_x = 0.9 \text{ for all } x$$

Question 26

In what range is  $A_{\overline{x}:x}$ ?

- (A) Less than 0.52
- (B) 0.52 but less than 0.58
- (C) 0.58 but less than 0.64
- (D) 0.64 but less than 0.70
- (E) 0.70 or more

Data for Question 27 (4 points)

The following are actuarially equivalent:

- I. \$100,000
- II. X payable annually at the end of each year during the joint life of two lives both age 40, payable for 10 years certain and up to 20 years thereafter while at least one is alive.

Selected annuity and mortality values:

$${}_{10}P_{40} = 0.8848$$

$${}_{20}P_{50} = 0.5217$$

$$a_{50} = 12.522$$

$$a_{70} = 6.293$$

$$a_{50:50} = 9.695$$

$$a_{70:70} = 4.054$$

Interest rate: 4.0%, compounded annually

Question 27

In what range is X?

- (A) Less than \$6,000
- (B) \$6,000 but less than \$6,100
- (C) \$6,100 but less than \$6,200
- (D) \$6,200 but less than \$6,300
- (E) \$6,300 or more

Data for Question 2 (3 points)

Selected actuarial values:

$$a_x = 10.0$$

$$a_y = 9.0$$

$$a_{xy} = 8.0$$

$$Z = 1000 \left( \sum_{t=0}^{\infty} {}_t p_{xy} \cdot v^{t+1} \right) + 500 \left( \sum_{t=0}^{\infty} v^{t+1} \cdot {}_t q_x \cdot {}_{t+1} p_y \cdot \ddot{a}_{y+t+1} \right)$$

Question 2

In what range is  $Z$ ?

- (A) Less than 8,750
- (B) 8,750 but less than 9,250
- (C) 9,250 but less than 9,750
- (D) 9,750 but less than 10,250
- (E) 10,250 or more

Data for Question 9 (3 points)

Data from a mortality table:

$x$	$q_x$
60	0.0156
61	0.0169
62	0.0184
63	0.0201

Interest rate: 5%, compounded annually.

Question 9

In what range is  $\ddot{a}_{60:62:\overline{3}|}$ ?

- (A) Less than 2.450
- (B) 2.450 but less than 2.550
- (C) 2.550 but less than 2.650
- (D) 2.650 but less than 2.750
- (E) 2.750 or more

Data for Question 17 (3 points)

Smith (age  $x$ ) and Jones (age  $y$ ) purchase a joint and survivor annuity with the following annual benefits payable at the beginning of each year:

- (1) \$500 while Smith and Jones are alive;
- (2) \$300 to Jones after Smith dies;
- (3)  $B$  to Smith after Jones dies.

The annuity is actuarially equivalent to a single life annuity with benefits of  $B$  payable to Smith.

Selected actuarial values:

$$\ddot{a}_x = 10.0$$

$$\ddot{a}_y = 14.0$$

$$\ddot{a}_{xy} = 8.0$$

Question 17

In what range is  $B$ ?

- (A) Less than \$580
- (B) \$580 but less than \$640
- (C) \$640 but less than \$700
- (D) \$700 but less than \$760
- (E) \$760 or more



Data for Question 29 (4 points)

Selected actuarial values:

$${}_{20}p_{30} = 0.75$$

$${}_{25}p_{50} = 0.55$$

$${}_{20}p_{55} = 0.60$$

$P =$  The probability that two independent lives, age 30 and age 50, will both die between ages 55 and 75.

Question 29

In what range is  $P$ ?

- (A) Less than 0.095
- (B) 0.095 but less than 0.105
- (C) 0.105 but less than 0.115
- (D) 0.115 but less than 0.125
- (E) 0.125 or more

Data for Question 30 (4 points)

Smith has the option of choosing any of the following actuarially equivalent annuities, with the first payment in one year:

- (1) A life annuity of \$1,000 per year.
- (2) A life annuity of  $X$  per year, with 50% of  $X$  payable to Smith's spouse after Smith's death.
- (3) A life annuity of \$875 per year, payable as long as Smith or Smith's spouse survives.

Question 30

In what range is  $X$ ?

- (A) Less than \$920
- (B) \$920 but less than \$925
- (C) \$925 but less than \$930
- (D) \$930 but less than \$935
- (E) \$935 or more

Data for Question 4 (5 points)

An annuity of \$10,000 is payable at the end of each year as long as at least one of three lives Smith (age 25), Jones (age 30), and Brown (age 35) is alive.

While all three are alive the \$10,000 is split as follows: Smith and Jones each receive \$2,500, and Brown receives \$5,000.

After the first death, the survivors split the share of the person dying equally. After the second death, the last survivor receives the entire annuity.

You are given the following values:

$$a_{25} = 17.95$$

$$a_{30} = 17.16$$

$$a_{35} = 16.22$$

$$a_{25:30} = 14.92$$

$$a_{25:35} = 14.48$$

$$a_{30:35} = 13.99$$

$$a_{25:30:35} = 12.68$$

$X$  = the present value of Smith's share.

Question 4

In what range is  $X$  ?

- (A) Less than \$61,500
- (B) \$61,500 but less than \$75,000
- (C) \$75,000 but less than \$88,500
- (D) \$88,500 but less than \$102,000
- (E) \$102,000 or more

2009

Data for Question 23 (3 points)

Smith (age 60) and Jones (age 61) are joint annuitants entitled to a joint and 100% survivor annuity paying \$1,000 at the beginning of each year commencing 1/1/2009.

Selected commutation functions:

$\underline{x}$	$\underline{D_x}$
60	285
61	267
...	...
64	219
65	205

$i = 6\%$ , compounded annually.

$X =$  the present value of 5<sup>th</sup> payment as of 1/1/2009.

Question 23

In what range is  $X$ ?

- (A) Less than \$720
- (B) \$720 but less than \$750
- (C) \$750 but less than \$780
- (D) \$780 but less than \$810
- (E) \$810 or more

2009

Data for Question 24 (3 points)

The following actuarially equivalent annuities are available to Smith:

- Annuity 1: Monthly payments of \$100 for life
- Annuity 2: Monthly payments of \$94 for life, with monthly payments of \$47 continuing for the life of Smith's surviving spouse
- Annuity 3: Monthly payments of  $X$  for life, with monthly payments of 75% of  $X$  continuing for the life of Smith's surviving spouse

Question 24

In what range is  $X$ ?

- (A) Less than \$90.52
- (B) \$90.52 but less than \$91.52
- (C) \$91.52 but less than \$92.52
- (D) \$92.52 but less than \$93.52
- (E) \$93.52 or more

Data for Question 31 (4 points)

$${}_tP_0^{(\text{Male})} = 1 - 0.01t, \quad t \leq 100$$

$${}_tP_0^{(\text{Female})} = (1 - 0.01t)^2, \quad t \leq 100$$

$X$  = the complete joint expectation of life for a male and a female, both age 80.

Question 31

In what range is  $X$ ?

- (A) Less than 4.5
- (B) 4.5 but less than 7.0
- (C) 7.0 but less than 9.5
- (D) 9.5 but less than 12.0
- (E) 12.0 or more

2010

Data for Question 3 (3 points)

Smith (age 65) has a spouse (age 60) as of 1/1/2010.

Smith is scheduled to commence a life annuity of \$1,000 per month beginning on 1/1/2010.

Instead of receiving this life annuity, Smith elects the actuarially equivalent benefit commencing 1/1/2010 described below:

$X$  per month while both Smith and Smith's spouse are alive, plus

$X$  per month to Smith's spouse for life after Smith's death, plus

\$1,000 per month to Smith for life after Smith's spouse's death.

Selected actuarial values:

$$\ddot{a}_{60}^{(12)} = 12.176$$

$$\ddot{a}_{65}^{(12)} = 10.194$$

$$\ddot{a}_{60:65}^{(12)} = 8.023$$

Question 3

In what range is  $X$ ?

- (A) Less than \$650
- (B) \$650 but less than \$700
- (C) \$700 but less than \$750
- (D) \$750 but less than \$800
- (E) \$800 or more

Data for Question 6 (4 points)

Selected annuity values:

$$\ddot{a}_{20} = 14.79$$

$$\ddot{a}_{50} = 12.56$$

$$\ddot{a}_{65} = 9.70$$

$$\ddot{a}_{20:50} = 12.51$$

$$\ddot{a}_{20:65} = 9.68$$

$$\ddot{a}_{50:65} = 9.48$$

$$\ddot{a}_{20:50:65} = 9.44$$

Question 6In what range is  $\ddot{a}_{65|\overline{20:50}|}$ ?

- (A) Less than 5.0
- (B) 5.0 but less than 6.0
- (C) 6.0 but less than 7.0
- (D) 7.0 but less than 8.0
- (E) 8.0 or more



## 2010

### Data for Question 14 (4 points)

Participant age on 1/1/2010: 65.

Joint annuitant age on 1/1/2010: 64.

Interest rate: 7.0%, compounded annually.

Joint annuity terms: Lifetime payments of \$10,000 annually at the beginning of the year with the first payment at 1/1/2010. Upon the first death of the participant or joint annuitant, the payment decreases to \$6,000 and this amount is payable until the second death.

Selected values:

$$1000q_{64} = 8.685$$

$$1000q_{65} = 9.816$$

$$a_{65} = 9.8207$$

$$a_{64:65} = 8.4129$$

### Question 14

In what range is the present value of the annuity on 1/1/2010?

- (A) Less than \$95,000
- (B) \$95,000 but less than \$105,000
- (C) \$105,000 but less than \$115,000
- (D) \$115,000 but less than \$125,000
- (E) \$125,000 or more

Terms of an annuity purchased on three lives ages  $x$ ,  $y$ , and  $z$ :

Issue date: 1/1/94.

Date of first payment: 12/31/94.

Frequency of payments: Annual.

Interest rate: 7% per year, compounded annually.

Annual payment if all three are alive: \$150.

Annual payment if exactly two are alive: \$120.

Annual payment if exactly one is alive: \$100.

Annual payment in perpetuity if none is alive: \$50.

Selected annuity values:

$$a_x + a_y + a_z = 38$$

$$a_{xy} + a_{xz} + a_{yz} = 35$$

$$a_{xyz} = 11$$

Question 19

In what range is the present value of the annuity as of 1/1/94?

- [A] Less than \$1,850
- [B] \$1,850 but less than \$1,950
- [C] \$1,950 but less than \$2,050
- [D] \$2,050 but less than \$2,150
- [E] \$2,150 or more

Data for Question 15

1994

Terms of an annuity:

\$10,000 payable each 1/1 as long as Smith is alive, plus  
\$6,000 payable each 1/1 as long as Brown is alive, plus  
\$3,000 payable each 1/1 as long as Green is alive but not beyond  
attainment of age 18.

Maximum annual payment: \$12,500.

Ages of annuitants as of 1/1/94:

Smith	45
Brown	35
Green	10

Selected annuity values:

$$\begin{array}{lll} \ddot{a}_{45} = 15 & \ddot{a}_{45:35} = 12 & \ddot{a}_{35:10:\overline{8}|} = 6.5 \\ \ddot{a}_{35} = 20 & \ddot{a}_{10:\overline{8}|} = 7 & \ddot{a}_{45:10:\overline{8}|} = 6 \\ & & \ddot{a}_{45:35:10:\overline{8}|} = 5 \end{array}$$

Question 15

In what range is the present value of the annuity as of 1/1/94?

- [A] Less than \$200,000
- [B] \$200,000 but less than \$210,000
- [C] \$210,000 but less than \$220,000
- [D] \$220,000 but less than \$230,000
- [E] \$230,000 or more

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