

AMERICAN SOCIETY OF PENSION PROFESSIONALS & ACTUARIES
JOINT BOARD FOR THE ENROLLMENT OF ACTUARIES
SOCIETY OF ACTUARIES

Enrolled Actuaries Basic Examination

EA-1

Date: Tuesday, May 1, 2018
Time: 8:30 a.m. – 11:00 a.m.

INSTRUCTIONS TO CANDIDATES

- Write your candidate number here _____. Your name must not appear.
 - Do not break the seal of this book until the supervisor tells you to do so.
 - Special conditions generally applicable to all questions on this examination are found at the front of this book.
 - On this examination the symbol “ a ” will be used to represent an annuity. On this examination the symbol “ ℓ_x ” will be used to represent the number of lives at age x .
 - This examination consists of 29 multiple-choice questions worth a total of 100 points. The point value for each question is shown in parentheses at the beginning of the question.
 - Your score will be based on the point values of questions that you answer correctly. No credit will be given for omitted answers and no credit will be lost for wrong answers; hence, you should answer all questions even those for which you have to guess.
 - A separate answer sheet is inside the front cover of this book. During the time allotted for this examination, record all your answers on side 2 of the answer sheet. **NO ADDITIONAL TIME WILL BE ALLOWED FOR THIS PURPOSE.** No credit will be given for anything indicated in the examination book but not transferred to the answer sheet. Failure to stop writing or coding your answer sheet after time is called will result in the disqualification of your answer sheet or further disciplinary action.
 - Five answer choices are given with each question, each answer choice being identified by a key letter (A to E). For each question, blacken the oval on the answer sheet that corresponds to the key letter of the answer choice that you select.
 - Use a soft-lead pencil to mark the answer sheet. To facilitate correct mechanical scoring, be sure that, for each question, your pencil mark is dark and completely fills only the intended oval. Make no stray marks on the answer sheet. If you have to erase, do so completely.
 - Do not spend too much time on any one question. If a question seems too difficult, leave it and go on.
 - While every attempt is made to avoid defective questions, sometimes they do occur. If you believe a question is defective, the supervisor or proctor cannot give you any guidance beyond the instructions on the exam booklet.
 - Clearly indicated answer choices in the test book can be an aid in grading examinations in the unlikely event of a lost answer sheet.
 - Use the blank portions of each page for your scratch work. Extra blank pages are provided at the back of the examination book.
 - When the supervisor tells you to do so, break the seal on the book and remove the answer sheet.

On the front of the answer sheet, space is provided to write and code candidate information. Complete the information requested by printing in the squares and blackening the circles (one in each column) corresponding to the letters or numbers printed. For each empty box blacken the small circle immediately above the “A” circle. Fill out the boxes titled:
 - Name
(Include last name, first name and middle initial)
 - Candidate Number
(Candidate/Eligibility Number, use leading zeros if needed to make it a five digit number)
 - Test Site Code
(The supervisor will supply the number.)
 - Examination Part
(Code the examination that you are taking by blackening the circle to the left of "Exam EA-1")
 - Booklet Number
(The booklet number can be found in the upper right-hand corner of this examination book. Use leading zeros if needed to make it a four digit number.)
- In the box titled “Complete this section only if instructed to do so”, fill in the circle to indicate if you are using a calculator and write in the make and model number.
- In the box titled “Signature and Date” sign your name and write today's date. **If the answer sheet is not signed, it will not be graded.**
- Leave the boxes titled “Test Code” and “Form Code” blank.
- On the back of the answer sheet fill in the Booklet Number in the space provided.
- After the examination, the supervisor will collect this book and the answer sheet separately. **DO NOT ENCLOSE THE ANSWER SHEET IN THE BOOK.** All books and answer sheets must be returned. **THE QUESTIONS ARE CONFIDENTIAL AND MAY NOT BE TAKEN FROM THE EXAMINATION ROOM.**

Answer Key EA-1 Spring 2018
May 15, 2018

Question	Answer		Question	Answer
1	C			
2	E			
3	C			
4	B			
5	A			
6	C			
7	B			
8	B			
9	D			
10	D			
11	C			
12	B			
13	B			
14	C			
15	C			
16	D			
17	D			
18	B			
19	B			
20	D			
21	D			
22	B			
23	E			
24	C			
25	B			
26	D			
27	B			
28	D			
29	D			

CONDITIONS GENERALLY APPLICABLE TO ALL EA-1 EXAMINATION QUESTIONS

If applicable, the following conditions should be considered a part of the data for each question, unless otherwise stated or implied:

- (1) The normal retirement age is 65.
- (2) Retirement pensions commence at normal retirement age and are paid monthly for life at the beginning of each month.
- (3) There are no pre-retirement death or disability benefits.
- (4) Actuarial equivalence is based on the mortality table and interest rate assumed for funding purposes.
- (5) Interest rates that are compounded more frequently than annually are expressed as nominal rates.
- (6) Where multiple lives are involved, future lifetimes are assumed to be independent of each other.
- (7) The term “gross single premium” is equivalent to “contract single premium;” the term “net single premium” is equivalent to “single benefit premium;” the term “gross annual premium” is equivalent to “annual contract premium;” the term “net annual premium” is equivalent to “annual benefit premium.”
- (8) There are no policy loans in effect.
- (9) For a bond, the face amount and the redemption value are the same.
- (10) Interest rate equals yield rate.
- (11) The term “duration” means “Macaulay duration”.

Data for Question 1 (3 points)

Smith makes a single deposit into a fund. The fund pays interest at the end of each 6-month period at a nominal annual rate of i compounded semi-annually.

Smith reinvests the interest payments in a separate fund earning interest at an annual effective rate of 6.00%.

After 15 years, Smith has earned an effective annual rate of return of 7.56%.

Question 1

In what range is i ?

- (A) Less than 8.31%
- (B) 8.31% but less than 8.37%
- (C) 8.37% but less than 8.43%
- (D) 8.43% but less than 8.49%
- (E) 8.49% or more

USE THIS PAGE FOR YOUR SCRATCH WORK

EXTRA BLANK PAPER IS PROVIDED AT THE END OF THE EXAM BOOK

Data for Question 2 (3 points)

Smith's age: 92

Jones's age: 93

Brown's age: 94

Selected values from a mortality table:

<u>x</u>	<u>ℓ_x</u>
92	1,000
93	913
94	822
95	723
96	615
97	498
98	378
99	246
100	143

X = the probability that at least one of Smith, Jones, or Brown will survive 6 years.

Question 2

In what range is X ?

- (A) Less than 0.30
- (B) 0.30 but less than 0.40
- (C) 0.40 but less than 0.50
- (D) 0.50 but less than 0.60
- (E) 0.60 or more

USE THIS PAGE FOR YOUR SCRATCH WORK

EXTRA BLANK PAPER IS PROVIDED AT THE END OF THE EXAM BOOK

Data for Question 3 (4 points)

Selected commutation functions:

<u>x</u>	<u>N_x</u>
64	294,298
65	263,044
66	234,434
67	208,299
68	184,481

Interest rate: 7.0% per year, compounded annually

$$X = a_{\overline{64:65:\overline{2}}}$$

Question 3

In what range is X ?

- (A) Less than 1.55
- (B) 1.55 but less than 1.65
- (C) 1.65 but less than 1.75
- (D) 1.75 but less than 1.85
- (E) 1.85 or more

USE THIS PAGE FOR YOUR SCRATCH WORK

EXTRA BLANK PAPER IS PROVIDED AT THE END OF THE EXAM BOOK

Data for Question 4 (4 points)

Terms of an annuity-due:

Payment period	10 years
Payments	\$1,000 per year for each of the first five years, payable in monthly installments; \$2,000 per year for each of the next five years, payable in semi-annual installments.

Interest rate: 6.0% per year, compounded quarterly.

X = the present value of the annuity.

Question 4

In what range is X ?

- (A) Less than \$10,500
- (B) \$10,500 but less than \$11,000
- (C) \$11,000 but less than \$11,500
- (D) \$11,500 but less than \$12,000
- (E) \$12,000 or more

USE THIS PAGE FOR YOUR SCRATCH WORK

EXTRA BLANK PAPER IS PROVIDED AT THE END OF THE EXAM BOOK

Data for Question 5 (3 points)

Terms of a retirement benefit available to a new employee hired at age 35 with an annual salary of \$50,000:

Retirement benefit	45% of final year's salary
Retirement age	65
Form of payment	Lifetime monthly payments, payable beginning at retirement

Assumptions:

Annual salary increases are 3.0% per year, effective on each anniversary of date of hire.

All employees work and survive until retirement.

$$\ddot{a}_{65}^{(12)} = 11.00$$

Interest is 5.0% per year, compounded annually.

X = the present value of future retirement benefits to this employee, determined as of this employee's date of hire.

Question 5

In what range is X ?

- (A) Less than \$135,500
- (B) \$135,500 but less than \$136,500
- (C) \$136,500 but less than \$137,500
- (D) \$137,500 but less than \$138,500
- (E) \$138,500 or more

USE THIS PAGE FOR YOUR SCRATCH WORK

EXTRA BLANK PAPER IS PROVIDED AT THE END OF THE EXAM BOOK

Data for Question 6 (3 points)

The following values are from a unisex mortality table:

x	N_x
65	10,606,828
66	9,611,140
67	8,675,145
68	7,797,981
69	6,978,762
70	6,216,553

The table is set forward 2 years for males, and is set back 1 year for females.

Smith (age 67) is male, with a life annuity-due of \$10,000 per year.

Jones (age 67) is female, with a life annuity-due of \$10,000 per year.

X = the net single premium for Smith

Y = the net single premium for Jones

Question 6

In what range is $|X - Y|$?

- (A) Less than \$11,000
- (B) \$11,000 but less than \$11,100
- (C) \$11,100 but less than \$11,200
- (D) \$11,200 but less than \$11,300
- (E) \$11,300 or more

USE THIS PAGE FOR YOUR SCRATCH WORK

EXTRA BLANK PAPER IS PROVIDED AT THE END OF THE EXAM BOOK

Data for Question 7 (4 points)

Terms of a bond:

Par value	\$1,000
Redemption value	\$1,100
Term of bond	10 years
Coupon rate	X per year, payable semiannually
Issue price	P if yield to maturity is 4.0% per year, compounded annually ($P - \$95.50$) if yield to maturity is 5.0% per year, compounded annually

Question 7

In what range is X ?

- (A) Less than 7.2%
- (B) 7.2% but less than 7.7%
- (C) 7.7% but less than 8.2%
- (D) 8.2% but less than 8.7%
- (E) 8.7% or more

USE THIS PAGE FOR YOUR SCRATCH WORK

EXTRA BLANK PAPER IS PROVIDED AT THE END OF THE EXAM BOOK

Data for Question 8 (3 points)

An insurance company is making annual payments under the terms of a lawsuit settlement.

A payment of \$30,000 has just been made, and 15 more payments are to be made.

Future payments are assumed to increase at the rate of 2.75% per year, compounded annually.

Interest is 6.00% per year, compounded annually.

X = the present value of the remaining obligation immediately after the \$30,000 payment.

Question 8

In what range is X ?

- (A) Less than \$353,000
- (B) \$353,000 but less than \$357,000
- (C) \$357,000 but less than \$361,000
- (D) \$361,000 but less than \$365,000
- (E) \$365,000 or more

USE THIS PAGE FOR YOUR SCRATCH WORK

EXTRA BLANK PAPER IS PROVIDED AT THE END OF THE EXAM BOOK

Data for Question 9 (3 points)

Selected values from a two decrement table used for a pension valuation, where death is represented by (d) and withdrawal is represented by (w):

$$q_x^{(d)} = 0.02 \text{ for all ages}$$

$$q_x^{(w)} = 0.04 \text{ for all ages}$$

The pension plan provides for a death benefit after 5 years of service and for a retirement benefit for anyone who terminates after attainment of age 55 with 5 years of service.

An employee was hired at age 58 and is currently age 60.

X = the probability that the employee receives either a death or retirement benefit from the plan.

Question 9

In what range is X ?

- (A) Less than 0.828
- (B) 0.828 but less than 0.830
- (C) 0.830 but less than 0.832
- (D) 0.832 but less than 0.834
- (E) 0.834 or more

USE THIS PAGE FOR YOUR SCRATCH WORK

EXTRA BLANK PAPER IS PROVIDED AT THE END OF THE EXAM BOOK

Data for Question 10 (4 points)

A 25-year endowment policy has three premium options that are actuarially equivalent:

Option 1	Years 1-5: \$272.70 per year Years 6-25: \$746.00 per year
Option 2	Years 1-5: \$136.10 per year Years 6-25: \$846.00 per year
Option 3	Years 1-25: P per year

All premiums are payable at the beginning of each year.

Question 10

In what range is P ?

- (A) Less than \$500
- (B) \$500 but less than \$520
- (C) \$520 but less than \$540
- (D) \$540 but less than \$560
- (E) \$560 or more

USE THIS PAGE FOR YOUR SCRATCH WORK

EXTRA BLANK PAPER IS PROVIDED AT THE END OF THE EXAM BOOK

Data for Question 11 (4 points)

Terms of a bond:

Face amount	\$1,000
Redemption amount	\$1,000
Term	40 years
Coupon rate	4.0% per year, payable annually
Yield rate	5.0% per year, compounded annually

X = the modified duration of the bond.

Question 11

In what range is X ?

- (A) Less than 17.4
- (B) 17.4 but less than 17.8
- (C) 17.8 but less than 18.2
- (D) 18.2 but less than 18.6
- (E) 18.6 or more

USE THIS PAGE FOR YOUR SCRATCH WORK

EXTRA BLANK PAPER IS PROVIDED AT THE END OF THE EXAM BOOK

Data for Question 12 (3 points)

At an annual effective interest rate i , the present value of a perpetuity paying \$1 at the beginning of each 6-month period is \$20.

At the same annual effective interest rate, i , the present value of a perpetuity paying X at the beginning of each 2-year period is also \$20.

Question 12

In what range is X ?

- (A) Less than \$3.65
- (B) \$3.65 but less than \$3.75
- (C) \$3.75 but less than \$3.85
- (D) \$3.85 but less than \$3.95
- (E) \$3.95 or more

USE THIS PAGE FOR YOUR SCRATCH WORK

EXTRA BLANK PAPER IS PROVIDED AT THE END OF THE EXAM BOOK

Data for Question 13 (3 points)

The probability that two independent lives ages 35 and 50 both survive 15 years is $\frac{7}{13}$.

The probability that a life age 25 will not survive to age 65 is $\frac{8}{15}$.

X = the probability that two independent lives, each age 25, both survive 10 years.

Question 13

In what range is X ?

- (A) Less than 0.725
- (B) 0.725 but less than 0.775
- (C) 0.775 but less than 0.825
- (D) 0.825 but less than 0.875
- (E) 0.875 or more

USE THIS PAGE FOR YOUR SCRATCH WORK

EXTRA BLANK PAPER IS PROVIDED AT THE END OF THE EXAM BOOK

Data for Question 14 (4 points)

At time $t=0$, a group of independent lives are all exactly age 80.

$$q_{80}=0.09$$

Deaths are uniformly distributed between ages 80 and 81.

At time $t=1/3$, an epidemic breaks out. The number of deaths that would have occurred during the remainder of the year increases by 20%. Deaths are still uniformly distributed.

$X = 1000 {}_{0.5}q_{80.5}$, reflecting the higher mortality after the epidemic.

Question 14

In what range is X ?

- (A) Less than 56.6
- (B) 56.6 but less than 56.7
- (C) 56.7 but less than 56.8
- (D) 56.8 but less than 56.9
- (E) 56.9 or more

USE THIS PAGE FOR YOUR SCRATCH WORK

EXTRA BLANK PAPER IS PROVIDED AT THE END OF THE EXAM BOOK

Data for Question 15 (3 points)

Term structure of interest rates:

<u>Length of investment (years)</u>	<u>Current spot rate</u>	<u>Assumed spot rate one year from now</u>
1	3.00%	3.75%
2	3.25%	4.00%
3	3.50%	4.25%
4	4.00%	4.75%
5	4.50%	5.25%

Payments of \$15,000 are to be made at the end of each of the next five years.

X = the present value of the remaining four payments, immediately after the first payment has been made.

Question 15

In what range is X ?

- (A) Less than \$53,000
- (B) \$53,000 but less than \$53,600
- (C) \$53,600 but less than \$54,200
- (D) \$54,200 but less than \$54,800
- (E) \$54,800 or more

USE THIS PAGE FOR YOUR SCRATCH WORK

EXTRA BLANK PAPER IS PROVIDED AT THE END OF THE EXAM BOOK

Data for Question 16 (3 points)

A substandard mortality table q_x^{Sub} is developed from a standard mortality table q_x as follows:

$$q_x^{Sub} = q_x \quad x \neq 29$$

$$q_x^{Sub} = q_x + 0.05, \quad x = 29$$

Using the standard mortality table, $e_{30} = 20$.

$$X = e_{29} - e_{29}^{Sub}$$

Question 16

In what range is X ?

- (A) Less than 0.91
- (B) 0.91 but less than 0.96
- (C) 0.96 but less than 1.01
- (D) 1.01 but less than 1.06

(E) 1.06 or more

USE THIS PAGE FOR YOUR SCRATCH WORK

EXTRA BLANK PAPER IS PROVIDED AT THE END OF THE EXAM BOOK

Data for Question 17 (4 points)

Smith (age 65) has a dependent, Jones (age 60), and has the option to choose between the following actuarially equivalent annuities:

- (1) A life annuity-due of \$1,000 per month payable to Smith.
- (2) An annuity-due that provides the following payment schedule:
 - (a) X per month while Smith and Jones are both alive;
 - (b) \$1,000 per month to Smith for life commencing on the death of Jones;
 - (c) $0.5X$ per month to Jones for life, commencing on the death of Smith.

Select values:

$$\ddot{a}_{60}^{(12)} = 12.20$$

$$\ddot{a}_{65}^{(12)} = 10.20$$

$$\ddot{a}_{60:65}^{(12)} = 8.00$$

Question 17

In what range is X ?

- (A) Less than \$675
- (B) \$675 but less than \$720
- (C) \$720 but less than \$765
- (D) \$765 but less than \$810
- (E) \$810 or more

USE THIS PAGE FOR YOUR SCRATCH WORK

EXTRA BLANK PAPER IS PROVIDED AT THE END OF THE EXAM BOOK

Data for Question 18 (4 points)

Smith (age 30) purchases a whole life insurance policy with a net single premium.

You are given the following information about the benefit and assumptions:

Face value \$100,000 payable at end of year of death

$$\text{Mortality assumption } \begin{cases} \ell_x = 10(110 - x); & 30 \leq x \leq 50 \\ \ell_x = 15(90 - x); & 50 \leq x \leq 60 \\ \ell_x = 9(110 - x); & x \geq 60 \end{cases}$$

Interest 4% per year, compounded annually

X = the net single premium.

Question 18

In what range is X ?

- (A) Less than \$31,000
- (B) \$31,000 but less than \$32,000
- (C) \$32,000 but less than \$33,000
- (D) \$33,000 but less than \$34,000
- (E) \$34,000 or more

USE THIS PAGE FOR YOUR SCRATCH WORK

EXTRA BLANK PAPER IS PROVIDED AT THE END OF THE EXAM BOOK

Data for Question 19 (3 points)

Pension fund information for a given year:

<u>Date</u>	<u>Deposits</u>	<u>Withdrawals</u>	<u>Fund balance</u>
1/1/2017	-	-	\$100,000
3/31/2017	-	\$10,000	-
4/1/2017	-	-	\$100,000
6/30/2017	\$50,000	\$10,000	-
7/1/2017	-	-	\$150,000
9/30/2017	-	\$10,000	-
10/1/2017	-	-	\$140,000
12/31/2017	-	\$10,000	-
1/1/2018	-	-	\$130,000

X = the dollar-weighted rate of return in the given year.

Question 19

In what range is X ?

- (A) Less than 17.9%
- (B) 17.9% but less than 18.9%
- (C) 18.9% but less than 19.9%
- (D) 19.9% but less than 20.9%
- (E) 20.9% or more

USE THIS PAGE FOR YOUR SCRATCH WORK

EXTRA BLANK PAPER IS PROVIDED AT THE END OF THE EXAM BOOK

Data for Question 20 (3 points)

Terms of a loan:

Repayment period	25 years
Payments	Level annual, payable at the end of each year
Interest	6.0% per year, compounded annually

The amount of principal in the 6th repayment is \$625.

X = the amount of interest in the 15th repayment.

Question 20

In what range is X ?

- (A) Less than \$800
- (B) \$800 but less than \$850
- (C) \$850 but less than \$900
- (D) \$900 but less than \$950
- (E) \$950 or more

USE THIS PAGE FOR YOUR SCRATCH WORK

EXTRA BLANK PAPER IS PROVIDED AT THE END OF THE EXAM BOOK

Data for Question 21 (4 points)

The formula to calculate the generational mortality rate q_x^{y+n} for a life age x in year $y+n$ is given by:

$$q_x^{y+n} = q_x^y \left[\prod_{z=1}^n (1 - f_{x,y+z}) \right],$$

Where

q_x^y is the mortality rate at age x from a base mortality table as of year y ,

$f_{x,y}$ is the annual rate of mortality improvement from a two-dimensional mortality improvement scale for age x in year y .

Selected values from a base mortality table as of 2017:

x	q_x^{2017}
100	0.270858
101	0.291040
102	0.311444

Selected values from a two-dimensional mortality improvement scale:

X	$f_{x,2017}$	$f_{x,2018}$	$f_{x,2019}$	$f_{x,2020}$
100	0.0113	0.0109	0.0104	0.0099
101	0.0105	0.0102	0.0097	0.0092
102	0.0098	0.0095	0.0090	0.0086

$$X = {}_3p_{100}^{2017}$$

Question 21

In what range is X ?

- (A) Less than 0.3550
- (B) 0.3550 but less than 0.3575
- (C) 0.3575 but less than 0.3600
- (D) 0.3600 but less than 0.3625
- (E) 0.3625 or more

USE THIS PAGE FOR YOUR SCRATCH WORK

EXTRA BLANK PAPER IS PROVIDED AT THE END OF THE EXAM BOOK

Data for Question 22 (4 points)

Selected commutation functions are shown below:

<u>X</u>	<u>D_x</u>
90	16,826.1
91	14,475.1
92	12,281.9
93	10,275.2
94	8,437.4
95	6,830.6
96	5,455.4

Deaths are assumed to be uniformly distributed between integral ages.

$$X = a_{90:\overline{5}|}^{(4)}$$

Question 22

In what range is X ?

- (A) Less than 3.32
- (B) 3.32 but less than 3.38
- (C) 3.38 but less than 3.44
- (D) 3.44 but less than 3.50
- (E) 3.50 or more

USE THIS PAGE FOR YOUR SCRATCH WORK

EXTRA BLANK PAPER IS PROVIDED AT THE END OF THE EXAM BOOK

Data for Question 23 (2 points)

Terms of a bond:

Face value of a bond	\$1,000
Bond price	\$980
Coupon rate	10.00% payable annually, at end of year
Risk-free yield rate	7.00%, compounded annually
Term of bond	One year
Implicit probability of default	q

Question 23

In what range is q ?

- (A) Less than 0.0450
- (B) 0.0450 but less than 0.0455
- (C) 0.0455 but less than 0.0460
- (D) 0.0460 but less than 0.0465
- (E) 0.0465 or more

USE THIS PAGE FOR YOUR SCRATCH WORK

EXTRA BLANK PAPER IS PROVIDED AT THE END OF THE EXAM BOOK

Data for Question 24 (3 points)

The probability that two independent lives ages 30 and 50 both survive 20 years is $\frac{11}{30}$.

The probability that a 30-year old dies by age 40 is 0.12.

X = the probability a life age 40 will not survive to age 70.

Question 24

In what range is X ?

- (A) Less than 0.40
- (B) 0.40 but less than 0.50
- (C) 0.50 but less than 0.60
- (D) 0.60 but less than 0.70
- (E) 0.70 or more

USE THIS PAGE FOR YOUR SCRATCH WORK

EXTRA BLANK PAPER IS PROVIDED AT THE END OF THE EXAM BOOK

Data for Question 25 (3 points)

For a double-decrement table:

$$q_x^{(2)} = 0.1250$$

$${}_1|q_x^{(1)} = 0.2292$$

$$q_{x+1}^{(1)} = 0.3333$$

$$X = q_x^{(1)}$$

Question 25

In what range is X ?

- (A) Less than 0.1000
- (B) 0.1000 but less than 0.2000
- (C) 0.2000 but less than 0.3000
- (D) 0.3000 but less than 0.4000
- (E) 0.4000 or more

USE THIS PAGE FOR YOUR SCRATCH WORK

EXTRA BLANK PAPER IS PROVIDED AT THE END OF THE EXAM BOOK

Data for Question 26 (4 points)

Terms of a bond:

Repayment period	10 years
Payments	Level annual payments of \$1,000.00, payable at the end of each year.
Default	If default occurs, no repayments will be made beyond the date of default.
Amount borrowed	If there is no probability of default during the repayment period, \$5,650.22. In the particular borrower's case, \$3,631.71.

X = the (constant) probability that a bond in good standing at the beginning of any year will default during that year.

Question 26

In what range is X ?

- (A) Less than 4.75%
- (B) 4.75% but less than 7.25%
- (C) 7.25% but less than 9.75%
- (D) 9.75% but less than 12.25%
- (E) 12.25% or more

USE THIS PAGE FOR YOUR SCRATCH WORK

EXTRA BLANK PAPER IS PROVIDED AT THE END OF THE EXAM BOOK

Data for Question 27 (4 points)

Smith (age 80) will receive payments of \$1,000 at the end of each quarter for the next year, if Smith is alive at the end of that quarter.

$$p_{80} = 0.9571$$

Deaths are assumed to be uniformly distributed between ages 80 and 81.

Interest rate: 4.00% per year, compounded annually.

X = the actuarial present value as of the beginning of the year of the payments to Smith.

Question 27

In what range is X ?

- (A) Less than \$3,799.00
- (B) \$3,799.00 but less than \$3,799.50
- (C) \$3,799.50 but less than \$3,800.00
- (D) \$3,800.00 but less than \$3,800.50
- (E) \$3,800.50 or more

USE THIS PAGE FOR YOUR SCRATCH WORK

EXTRA BLANK PAPER IS PROVIDED AT THE END OF THE EXAM BOOK

Data for Question 28 (4 points)

A yield curve is broken into three 5-year segments and produces the following yields-to-maturity, compounded annually, for an investment made immediately:

<u>Time to maturity</u> <u>(years)</u>	<u>Yield-to-maturity</u>
5	4.00%
10	4.50%
15	4.83%

Assume that the one-year forward rates remain the same within each yield curve segment, and that the yield curve at time $t=0$ is exactly realized over time.

An investor will make an investment of \$1,000 at the end of year 8 and another investment of \$1,000 at the end of year 12.

X = the accumulated value of the total investment at the end of year 15.

Question 28

In what range is X ?

- (A) Less than \$2,500
- (B) \$2,500 but less than \$2,550
- (C) \$2,550 but less than \$2,600
- (D) \$2,600 but less than \$2,650
- (E) \$2,650 or more

USE THIS PAGE FOR YOUR SCRATCH WORK

EXTRA BLANK PAPER IS PROVIDED AT THE END OF THE EXAM BOOK

Data for Question 29 (4 points)

Smith (age 60) retires and is offered the following distribution options from a pension plan:

- (a) A life annuity of \$1,000 payable annually commencing immediately.
- (b) A lump sum of \$15,000 payable at age 65, if Smith is still alive at that age, and no benefit if Smith is not alive at that age.

Selected assumptions:

$$\ell_x = 100 - x, 0 \leq x \leq 100$$

Interest rate: 6.0% per year, compounded annually

X = the present value of option (a) at age 60

Y = the present value of option (b) at age 60

Question 29

In what range is $|X - Y|$?

- (A) Less than \$400
- (B) \$400 but less than \$800
- (C) \$800 but less than \$1,200
- (D) \$1,200 but less than \$1,600
- (E) \$1,600 or more

****END OF EXAMINATION****

USE THIS PAGE FOR YOUR SCRATCH WORK

USE THIS PAGE FOR YOUR SCRATCH WORK

USE THIS PAGE FOR YOUR SCRATCH WORK

USE THIS PAGE FOR YOUR SCRATCH WORK