CASUALTY ACTUARIAL SOCIETY

AND THE

CANADIAN INSTITUTE OF ACTUARIES

Exam 3

Actuarial Models

October 31, 2006

4 HOURS

INSTRUCTIONS TO CANDIDATES

1. This 80 point examination consists of 40 multiple choice questions worth 2 points each.

2. To answer the multiple choice questions, use the short-answer card provided and a number 2 or HB pencil only.

   - Fill in that it is Fall 2006 and that the exam number is 3.
   - Darken the spaces corresponding to your Candidate ID number. Four rows are available. If your Candidate ID number is fewer than 4 digits, include leading zeros. For example, if your Candidate ID number is 987, consider that your Candidate ID number is 00987, enter a zero on the first row, 9 on the second row, 8 on the third row, 7 on the fourth [last] row. Please write in your Candidate ID number next to the place where you darken the spaces for your Candidate ID number. Your name, or any other identifying mark, must not appear on the short-answer card.
   - Mark your short-answer card during the examination period. No additional time will be allowed for this after the exam has ended. Please make your marks dark and fill in the spaces completely.
   - For each of the multiple choice questions, select the one best answer and fill in the corresponding letter. One quarter of the point value of the question will be subtracted for each incorrect answer. No points will be added or subtracted for responses left blank.

3. Do all problems until you reach the last page of the examination where "END OF EXAMINATION" is marked.

4. Prior to the start of the exam you will have a **fifteen-minute reading period** in which you can silently read the questions and check the exam booklet for missing or defective pages. Writing will NOT be permitted during this time and you will not be permitted to hold pens or pencils. You will also not be allowed to use calculators. The supervisor has additional exams for those candidates who have defective exam booklets.

   - Verify that you have a copy of "Tables for CAS Exam 3" included in your exam packet.

5. Your Examination Envelope is pre-labeled with your Candidate ID number, name, exam number, and test center. Do not remove this label. Keep a record of your Candidate ID number for future inquiries regarding this exam.

CONTINUE TO NEXT PAGE OF INSTRUCTIONS

6. Candidates must remain in the examination center until two hours after the start of the examination. You may leave the examination room to use the restroom with permission from the supervisor. To avoid excessive noise during the end of the examination, candidates may not leave the exam room during the last fifteen minutes of the examination.

7. At the end of the examination, place the short-answer card in the Examination Envelope. Nothing written in the examination booklet will be graded. Only the short-answer card and the answer sheets will be graded. Also place any included reference materials in the Examination Envelope. BEFORE YOU TURN THE EXAMINATION ENVELOPE IN TO THE SUPERVISOR, BE SURE TO SIGN IT IN THE SPACE PROVIDED ABOVE THE CUT-OUT WINDOW.

8. If you have brought a self-addressed, stamped envelope, you may put the examination booklet and scrap paper inside and submit it separately to the supervisor. It will be mailed to you. Do not put the self-addressed stamped envelope inside the Examination Envelope.

   If you do not have a self-addressed, stamped envelope, please place the examination booklet in the Examination Envelope and seal the envelope. You may not take it with you. Do not put scrap paper in the Examination Envelope. The supervisor will collect your scrap paper.

   Candidates may obtain a copy of the examination from the CAS Web Site.

   All extra answer sheets, scrap paper, etc., must be returned to the supervisor for disposal.

9. Candidates must not give or receive assistance of any kind during the examination. Any cheating, any attempt to cheat, assisting others to cheat, or participating therein, or other improper conduct will result in the Casualty Actuarial Society and the Canadian Institute of Actuaries disqualifying the candidate's paper, and such other disciplinary action as may be deemed appropriate within the guidelines of the CAS Policy on Examination Discipline.

10. The exam survey is available on the CAS website in the "Admissions/Exams" section. Please submit your survey by November 20, 2006.

END OF INSTRUCTIONS

EXAM 3, FALL 2006

1. Claim sizes are described by an exponential distribution with parameter θ.

   The probability density function of the order statistic Y_k with a sample size n is
   $\frac{n!}{(k-1)!(n-k)!}[F(y)]^{k-1}[1-F(y)]^{n-k} f(y)$.

   For a sample of size 5, determine the bias in using Y_3, the third order statistic, as an estimate of the median of the distribution.

   A. Less than 0.05θ
   B. At least 0.05θ, but less than 0.08θ
   C. At least 0.08θ, but less than 0.10θ
   D. At least 0.10θ, but less than 0.13θ
   E. At least 0.13θ

CONTINUED ON NEXT PAGE

2. Call center response times are described by the cumulative distribution function $F(x) = x^{\theta+1}$, where $0 \le x \le 1$ and $\theta > -1$.

A random sample of response times is as follows:

0.56 0.83 0.74 0.68 0.75

Calculate the maximum likelihood estimate of θ.

A. Less than 1.4
B. At least 1.4, but less than 1.6
C. At least 1.6, but less than 1.8
D. At least 1.8, but less than 2.0
E. At least 2.0

CONTINUED ON NEXT PAGE

3. Claim sizes of 10 or greater are described by a single parameter Pareto distribution, with parameter α. A sample of claim sizes is as follows:

10	12	14	18	21	25

Calculate the method of moments estimate for α for this sample.

A. Less than 2.0
B. At least 2.0, but less than 2.1
C. At least 2.1, but less than 2.2
D. At least 2.2, but less than 2.3
E. At least 2.3

CONTINUED ON NEXT PAGE

4. Claim counts, N, are described by a probability distribution that depends on θ, which can take on two values, θ_0 or θ_1. The possible probability distribution results are shown below:

n	0	1	2	3	4	5
$f(n; \theta_0)$	0.01	0.04	0.05	0.06	0.30	0.54
$f(n; \theta_1)$	0.04	0.04	0.09	0.05	0.40	0.38

The Neyman-Pearson Lemma and a single observation are used to test these hypotheses:

$H_0: \theta = \theta_0$
$H_1: \theta = \theta_1$

Which of the following points is in the critical region defined by a significance level of 5%?

A. n is 0 or 1
B. n is 2
C. n is 3
D. n is 4
E. n is 5

CONTINUED ON NEXT PAGE

5. The following table displays the number of policyholders by territory by number of claims:

Number of Claims	Territory 1	Territory 2	Territory 3	Territory 4	Total
0	97	188	392	293	970
1	2	10	4	4	20
2	1	2	4	3	10
Total	100	200	400	300	1,000

You are testing the hypothesis that the claim count distributions are the same in each territory using a Chi-Square goodness of fit test with a significance level of 5%.

Calculate the absolute value of the difference between the test statistic and the critical value.

A. Less than 0.30
B. At least 0.30, but less than 0.40
C. At least 0.40, but less than 0.50
D. At least 0.50, but less than 0.60
E. At least 0.60

CONTINUED ON NEXT PAGE

6. You are testing the hypothesis H_0 that the random variable X has a uniform distribution on [0,10] against the alternative hypothesis H_1 that X is uniform on [5,10].

   Using a single observation and a significance level of 5%, calculate the probability of a Type II error.

   A. Less than 0.2
   B. At least 0.2, but less than 0.4
   C. At least 0.4, but less than 0.6
   D. At least 0.6, but less than 0.8
   E. At least 0.8

CONTINUED ON NEXT PAGE

7. A random sample of 21 observations from a normal distribution yields the following results:

$$\overline{X} = 3.5$$

$$\frac{\sum_{i=1}^{21}(X_i - \overline{X})^2}{20} = 0.6156$$

You are testing the following hypotheses:

$$H_0 : \mu = 3$$
$$H_1 : \mu \neq 3$$

Calculate the p-value for this test.

A. Less than 0.002
B. At least 0.002, but less than 0.004
C. At least 0.004, but less than 0.006
D. At least 0.006, but less than 0.008
E. At least 0.008

CONTINUED ON NEXT PAGE

8. Mr. Smith is buying a ring valued at $1,200 and wishes to insure it. The jeweler provides him with the following information to estimate the insurance premium, y_i, based on the value of the ring, x_i (in 000's):

$$y_i = \alpha + \beta x_i$$

$$\sum_{i=1}^{5}(x_i - \bar{x})^2 = 10$$

$$\sum_{i=1}^{5}(x_i - \bar{x})(y_i - \bar{y}) = 195$$

$$\bar{x} = 3$$

$$\bar{y} = 45$$

Using least squares regression, calculate the predicted premium for the ring.

A. Less than 9.75
B. At least 9.75, but less than 10.00
C. At least 10.00, but less than 10.25
D. At least 10.25, but less than 10.50
E. At least 10.50

CONTINUED ON NEXT PAGE

9. Claim sizes follow an exponential distribution with $\theta = 200$. A random sample of size 10 has been drawn.

   The probability density function of the order statistic Y_k with a sample size n is $\frac{n!}{(k-1)!(n-k)!}[F(y)]^{k-1}[1-F(y)]^{n-k} f(y)$.

   Calculate the probability that the second smallest claim will be larger than 50.

   A. Less than 0.30
   B. At least 0.30, but less than 0.35
   C. At least 0.35, but less than 0.40
   D. At least 0.40, but less than 0.45
   E. At least 0.45

CONTINUED ON NEXT PAGE

10. You are given the following 2-year Select-and-Ultimate table:

x	q_x	$q_{[x]}$	$q_{[x]+1}$
60	0.014	0.020	0.030
61	0.026	0.032	0.038
62	0.040	0.044	0.048

Calculate ${}_{1|2}q_{[60]}$.

A. Less than 0.066
B. At least 0.066, but less than 0.067
C. At least 0.067, but less than 0.068
D. At least 0.068, but less than 0.069
E. At least 0.069

CONTINUED ON NEXT PAGE

11. Using the Illustrative Life Table, calculate the average number of complete years lived between ages 60 and 65.

    A. Less than 4.70
    B. At least 4.70, but less than 4.75
    C. At least 4.75, but less than 4.80
    D. At least 4.80, but less than 4.85
    E. At least 4.85

CONTINUED ON NEXT PAGE

12. For two independent lives (55) and (60), you are given:

- $s(55) = 0.90$
- $s(60) = 0.85$
- ${}_{55|20}q_0 = 0.25$
- ${}_{60|20}q_0 = 0.30$

Calculate the probability that at least one of the lives survives 20 years.

A. Less than 0.75
B. At least 0.75, but less than 0.80
C. At least 0.80, but less than 0.85
D. At least 0.85, but less than 0.90
E. At least 0.90

CONTINUED ON NEXT PAGE

13. Using the Illustrative Life Table and the uniform distribution of death assumption, which of the following are true?

    1. ${}_{0.25}p_{62}\,{}_{0.5}q_{62.25} = 0.00410$
    2. ${}_{0.25}q_{62.5} < {}_{0.25}q_{62.75}$
    3. ${}_{0.25}p_{62}\,\mu(62.25) = q_{62}$

A. 1 only
B. 3 only
C. 1 and 2 only
D. 2 and 3 only
E. 1, 2, and 3

CONTINUED ON NEXT PAGE

14. For two independent lives (30) and (40), you are given:

- Mortality follows DeMoivre with $\omega = 110$.
- ${}_{10|10}q_{30:40}$ is the probability that the first death occurs between 10 and 20 years from now.
- ${}_{10|10}q_{\overline{30:40}}$ is the probability that the last death occurs between 10 and 20 years from now.

Calculate ${}_{10|10}q_{30:40} - {}_{10|10}q_{\overline{30:40}}$.

A. Less than 0.155
B. At least 0.155, but less than 0.175
C. At least 0.175, but less than 0.195
D. At least 0.195, but less than 0.215
E. At least 0.215

CONTINUED ON NEXT PAGE

15. A hospital is considering the purchase of a power supply system using two new independent generators. System X provides power as long as both generators are working. System Y provides power as long as at least one generator is working.

    For all generators and for t<10, ${}_tq_0 = t^2/100$.

    Calculate the difference in expected lifetimes of system X and system Y.

    A. Less than 1.5 years
    B. At least 1.5 years, but less than 3.0 years
    C. At least 3.0 years, but less than 4.5 years
    D. At least 4.5 years, but less than 6.0 years
    E. At least 6.0 years

CONTINUED ON NEXT PAGE

16. You are given the following 2-decrement table:

x	$q_x^{(1)}$	$q_x^{(2)}$
65	0.02	0.05
66	0.03	0.06
67	0.04	0.07
68	0.05	0.08
69	0.06	0.09
70	0.00	1.00

Calculate the difference between ${}_{4}q_{65}^{(\tau)}$ and ${}_{3|}q_{65}^{(1)}$.

A. Less than 0.24
B. At least 0.24, but less than 0.26
C. At least 0.26, but less than 0.28
D. At least 0.28, but less than 0.30
E. At least 0.30

CONTINUED ON NEXT PAGE

17. For a 20-year term life insurance on (x), you are given:

- $i = 0$
- $\mu_{x+t}^{(1)} = t/20$, the force of mortality due to accident
- $\mu_{x+t}^{(2)} = t/10$, the force of mortality due to other causes
- The benefit is paid at the moment of death.
- A benefit of 2 is paid if death occurs by accident, and a benefit of 1 is paid if death occurs by other causes.

Calculate the actuarial present value of this insurance.

A. $2/3(1 - e^{-20})$
B. $1 - e^{-20}$
C. $1 - e^{-30}$
D. $1 - e^{-40}$
E. $4/3(1 - e^{-30})$

CONTINUED ON NEXT PAGE

18. A loss distribution is a two-component spliced model using a Weibull distribution with $\theta_1 = 1{,}500$ and $\tau = 1$ for losses up to \$4,000, and a Pareto distribution with $\theta_2 = 12{,}000$ and $\alpha = 2$ for losses \$4,000 and greater. The probability that losses are less than \$4,000 is 0.60.

    Calculate the probability that losses are less than \$25,000.

    A. Less than 0.900
    B. At least 0.900, but less than 0.925
    C. At least 0.925, but less than 0.950
    D. At least 0.950, but less than 0.975
    E. At least 0.975

CONTINUED ON NEXT PAGE

19. In 2006, annual claim frequency follows a negative binomial distribution with parameters β and r. β follows a uniform distribution on the interval (0,2) and $r = 4$.

Calculate the probability that there is at least 1 claim in 2006.

A. Less than 0.85
B. At least 0.85, but less than 0.88
C. At least 0.88, but less than 0.91
D. At least 0.91, but less than 0.94
E. At least 0.94

CONTINUED ON NEXT PAGE

20. An insurance company sells hospitalization reimbursement insurance. You are given:

- Benefit payment for a standard hospital stay follows a lognormal distribution with $\mu = 7$ and $\sigma = 2$.
- Benefit payment for a hospital stay due to an accident is twice as much as a standard benefit.
- 25% of all hospitalizations are for accidental causes.

Calculate the probability that a benefit payment will exceed $15,000.

A. Less than 0.12
B. At least 0.12, but less than 0.14
C. At least 0.14, but less than 0.16
D. At least 0.16, but less than 0.18
E. At least 0.18

CONTINUED ON NEXT PAGE

21. For independent lives (x) and (y), State 1 is that (x) and (y) are alive, State 2 that (x) is alive but (y) has died, State 3 that (y) is alive but (x) has died, and State 4 that both (x) and (y) have died.

You are given:

- $s_x(x) = (1 - x/100)^{1/2}$, $0 \le x \le 100$
- $s_y(y) = (1 - y/100)$, $0 \le y \le 100$
- $Q_n^{(i,j)}$ is the probability that (x) and (y) are in State j at time n+1 given that they are in State i at time n.
- At time 0, (x) is age 54 and (y) is age 75.

Calculate $Q_{10}^{(1,2)}$.

A. Less than 0.026
B. At least 0.026, but less than 0.039
C. At least 0.039, but less than 0.052
D. At least 0.052, but less than 0.065
E. At least 0.065

CONTINUED ON NEXT PAGE

22. For a non-homogenous Markov chain with States X, Y, and Z, the following matrices show the probability of movement between states at times 1, 2, and 3.

$$Q_0 = \begin{pmatrix} 0.4 & 0.5 & 0.1 \\ 0.0 & 1.0 & 0.0 \\ 0.0 & 0.0 & 1.0 \end{pmatrix} \qquad Q_1 = \begin{pmatrix} 0.2 & 0.6 & 0.2 \\ 0.0 & 1.0 & 0.0 \\ 0.0 & 0.0 & 1.0 \end{pmatrix} \qquad Q_2 = \begin{pmatrix} 0.0 & 0.6 & 0.4 \\ 0.0 & 1.0 & 0.0 \\ 0.0 & 0.0 & 1.0 \end{pmatrix}$$

Calculate the probability that a subject in State X at time 0 will be in State Z at time 3.

A. Less than 0.16
B. At least 0.16, but less than 0.18
C. At least 0.18, but less than 0.20
D. At least 0.20, but less than 0.22
E. At least 0.22

CONTINUED ON NEXT PAGE

23. An actuary has determined that the number of claims follows a negative binomial distribution with mean 3 and variance 12.

Calculate the probability that the number of claims is at least 3 but less than 6.

A. Less than 0.20
B. At least 0.20, but less than 0.25
C. At least 0.25, but less than 0.30
D. At least 0.30, but less than 0.35
E. At least 0.35

CONTINUED ON NEXT PAGE

24. Two independent random variables, X_1 and X_2, follow the negative binomial distribution with parameters (r_1, β_1) and (r_2, β_2), respectively.

Under which of the following circumstances will $X_1 + X_2$ always be negative binomial?

1. $r_1 = r_2$
2. $\beta_1 = \beta_2$
3. The coefficients of variation of X_1 and X_2 are equal.

A. 1 only
B. 2 only
C. 3 only
D. 1 and 3 only
E. 2 and 3 only

CONTINUED ON NEXT PAGE

25. You are given the following information about the probability generating function for a discrete distribution:

- $P'(1) = 2$
- $P''(1) = 6$

Calculate the variance of the distribution.

A. Less than 1.5
B. At least 1.5, but less than 2.5
C. At least 2.5, but less than 3.5
D. At least 3.5, but less than 4.5
E. At least 4.5

CONTINUED ON NEXT PAGE

26. Which of the following is/are true?

    1. A counting process is said to possess independent increments if the number of events that occur between time s and t is independent of the number of events that occur between time s and $t+u$ for all $u>0$.
    2. All Poisson processes have stationary and independent increments.
    3. The assumption of stationary and independent increments is essentially equivalent to asserting that at any point in time the process probabilistically restarts itself.

    A. 1 only
    B. 2 only
    C. 3 only
    D. 1 and 2 only
    E. 2 and 3 only

CONTINUED ON NEXT PAGE

27. A customer service operator accepts calls continuously throughout the work day. The length of each call is exponentially distributed with an average of 3 minutes.

Calculate the probability that at least one call will be completed in the next 2 minutes.

A. Less than 0.50
B. At least 0.50, but less than 0.55
C. At least 0.55, but less than 0.60
D. At least 0.60, but less than 0.65
E. At least 0.65

CONTINUED ON NEXT PAGE

28. Customers arrive to buy lemonade according to a Poisson distribution with $\lambda(t)$, where t is time in hours, as follows:.

$$\lambda(t) = \begin{cases} 2+6t & 0 \le t \le 3 \\ 20 & 3 < t \le 4 \\ 36-4t & 4 < t \le 8 \end{cases}$$

At 9:00 a.m., t is 0.

Calculate the number of customers expected to arrive between 10:00 a.m. and 2:00 p.m.

A. Less than 63
B. At least 63, but less than 65
C. At least 65, but less than 67
D. At least 67, but less than 69
E. At least 69

CONTINUED ON NEXT PAGE

29. Frequency of losses follows a binomial distribution with parameters $m = 1{,}000$ and $q = 0.3$. Severity follows a Pareto distribution with parameters $\alpha = 3$ and $\theta = 500$.

Calculate the standard deviation of the aggregate losses.

A. Less than 7,000
B. At least 7,000, but less than 7,500
C. At least 7,500, but less than 8,000
D. At least 8,000, but less than 8,500
E. At least 8,500

CONTINUED ON NEXT PAGE

30. An insurance company offers two policies. Policy R has no deductible and no limit. Policy S has a deductible of $500 and a limit of $3,000; that is, the company will pay the loss amount between $500 and $3,000. In year t, severity follows a Pareto distribution with parameters $\alpha = 4$ and $\theta = 3{,}000$. The annual inflation rate is 6%.

    Calculate the difference in expected cost per loss between policies R and S in year t+4.

    A. Less than $500
    B. At least $500, but less than $550
    C. At least $550, but less than $600
    D. At least $600, but less than $650
    E. At least $650

CONTINUED ON NEXT PAGE

31. You are given the following information for a group of policyholders:

- The frequency distribution is negative binomial with $r = 3$ and $\beta = 4$.
- The severity distribution is Pareto with $\alpha = 2$ and $\theta = 2{,}000$.

Calculate the variance of the number of payments if a $500 deductible is introduced.

A. Less than 30
B. At least 30, but less than 40
C. At least 40, but less than 50
D. At least 50, but less than 60
E. At least 60

CONTINUED ON NEXT PAGE

32. You are given:

- Annual frequency follows a Poisson distribution with mean 0.3.
- Severity follows a normal distribution with $F(100{,}000) = 0.6$.

Calculate the probability that there is at least one loss greater than 100,000 in a year.

A. Less than 11%
B. At least 11%, but less than 13%
C. At least 13%, but less than 15%
D. At least 15%, but less than 17%
E. At least 17%

CONTINUED ON NEXT PAGE

33. For a 5-year deferred whole life insurance of 1 on (x), you are given:

- $\delta = 0.06$
- $\mu = 0.04$
- The benefit is paid at the moment of death.
- Z is the present value random variable of the insurance benefit.

Calculate Var(Z).

A. Less than 0.05
B. At least 0.05, but less than 0.06
C. At least 0.06, but less than 0.07
D. At least 0.07, but less than 0.08
E. At least 0.08

CONTINUED ON NEXT PAGE

34. For a fully discrete 20-year term life insurance of 1 on a life aged 90, you are given:

- $i = 10\%$ for the first two years and $i = 6\%$ thereafter.
- Mortality follows the Illustrative Life Table.

Calculate $A^{1}_{90:\overline{20|}}$.

A. Less than 0.71
B. At least 0.71, but less than 0.73
C. At least 0.73, but less than 0.75
D. At least 0.75, but less than 0.77
E. At least 0.77

CONTINUED ON NEXT PAGE

35. An appliance store sells microwave ovens with a 3-year warranty against failure. At the time of purchase, the consumer may buy a 2-year extended warranty that would pay half of the original purchase price at the moment of failure.

You are given:

- The extended warranty period begins exactly 3 years after the time of purchase, but only if the oven has not failed by then.
- Any failure is considered permanent.
- $\delta = 4\%$
- Failure of the ovens follows the mortality table below, with uniform distribution of failure within each year:

Age (x)	q_x
0	0.008
1	0.015
2	0.026
3	0.042
4	0.063
5	0.089

Calculate the actuarial present value of the extended warranty as a percent of the purchase price.

A. Less than 3.8%
B. At least 3.8%, but less than 4.1%
C. At least 4.1%, but less than 4.4%
D. At least 4.4%, but less than 4.7%
E. At least 4.7%

CONTINUED ON NEXT PAGE

36. The city of Stevens Crossing wishes to insure a 50-year-old bridge against collapse for the next 25 years. The present mayor, concerned with the tax burden of the premium on the 2,000 residents of Stevens Crossing, proposes the following scheme:

- A benefit of $10 million is payable at the end of the year that the bridge collapses.
- Each resident of Stevens Crossing would pay an annual premium of P payable at the beginning of the year for the next 10 years and 1.2P for the remaining 15 years of the term.
- In the event of bridge collapse, premium payments cease.

The city's actuary has determined the following:

- The number of residents of Stevens Crossing will remain steady over the next 25 years.
- The bridge mortality follows the Illustrative Life Table with $i = 6\%$.

Calculate P, the initial annual premium per resident.

A. Less than 45
B. At least 45, but less than 50
C. At least 50, but less than 55
D. At least 55, but less than 60
E. At least 60

CONTINUED ON NEXT PAGE

37. For a fully discrete whole life insurance on (x) with a benefit of 1, you are given:

- i = 5%
- $_{k|}q_x = \frac{k+1}{10}$ for k = 0, 1, 2, 3

Calculate the benefit reserve at time 2.

A. Less than 0.32
B. At least 0.32, but less than 0.36
C. At least 0.36, but less than 0.40
D. At least 0.40, but less than 0.44
E. At least 0.44

CONTINUED ON NEXT PAGE

38. Robin is initially classified as a Standard driver. At the beginning of each subsequent year, Robin will transition between the classes (1) Preferred, (2) Standard, and (3) Non-Standard according to the following transition matrix:

$$\begin{bmatrix} 0.60 & 0.30 & 0.10 \\ 0.30 & 0.50 & 0.20 \\ 0.00 & 0.40 & 0.60 \end{bmatrix}$$

Standard premium is \$500. A discount of \$50 is applied to Preferred premium and a surcharge of \$75 is applied to Non-Standard premium. Premiums are paid at the beginning of each year. The annual interest rate is 5%.

Calculate the actuarial present value of the premium paid by Robin in the first three years.

A. Less than 1,430
B. At least 1,430, but less than 1,460
C. At least 1,460, but less than 1,490
D. At least 1,490, but less than 1,520
E. At least 1,520

CONTINUED ON NEXT PAGE

39. You are given the following information about an insurance company:

- Initial surplus = \$3
- Premiums are collected at the beginning of each year.
- Losses are paid at the end of each year and follow the distribution below:

Annual Losses	Probability
0	0.4
10	0.5
25	0.1

  There are no other costs.

- $i = 15\%$
- Interest is earned on funds available at the beginning of each year.

The company wishes to maintain a probability of ruin in the first year of no more than 10%.

Which of the following is the lowest premium the company can collect under this ruin constraint?

A. 3
B. 4
C. 5
D. 6
E. 7

CONTINUED ON NEXT PAGE

40. You are given the following information about an insurance company:

- Initial surplus = \$6
- A premium of \$10 is collected at the beginning of each year.
- Losses are paid at the end of each year and follow the distribution below:

Annual Losses	Probability
0	0.5
10	0.4
25	0.1

  There are no other costs.

- $i = 0\%$
- Interest is earned on funds available at the beginning of each year.

Calculate the probability that the company will survive the next two years.

A. Less than 0.81
B. At least 0.81, but less than 0.83
C. At least 0.83, but less than 0.85
D. At least 0.85, but less than 0.87
E. At least 0.87

END OF EXAM

Exam 3
Fall 2006 Answer Key
(12 December 2006)

Question	Answer
1	C
2	D
3	E
4	B
5	E
6	E
7	E
8	B
9	B
10	C
11	C
12	E
13	D
14	B
15	B
16	E
17	E
18	C
19	A
20	A
21	E
22	D
23	B
24	B
25	D
26	C
27	A
28	C
29	D
30	D
31	A
32	B
33	B
34	C
35	C
36	E
37	E
38	B
39	D
40	D