CASUALTY ACTUARIAL SOCIETY
AND THE
CANADIAN INSTITUTE OF ACTUARIES

James K. Christie
Vice President-Admissions

Arlie J. Proctor
Chairperson
Examination Committee

Exam 3

Actuarial Models

Examination Committee
General Officers
Steven D. Armstrong
Arthur Placek
Virginia Prevosto
Daniel G. Roth
Thomas Struppeck
Rhonda Port Walker

October 30, 2007

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 2007 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 0987, enter a zero on the first row, 9 on the second row, 8 on the third row, and 7 on the fourth [last] row. 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. 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.

CONTINUE TO NEXT PAGE OF INSTRUCTIONS

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.

6. Candidates must remain in the examination center until two hours after the start of the examination. The examination starts after the reading period is complete. 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 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 Web Site in the "Admissions/Exams" section. Please submit your survey by November 19, 2007.

END OF INSTRUCTIONS

1.

You are given the following information about the inter arrival times for tornadoes in county XYZ.

- The waiting time in days between tornadoes follows an exponential distribution and remains constant throughout the year.
- The probability that more than 30 days elapses between tornadoes is .60.

Calculate the expected number of tornadoes in the next 90 days.

A. Less than 1.0
B. At least 1.0, but less than 1.5
C. At least 1.5, but less than 2.0
D. At least 2.0, but less than 2.5
E. At least 2.5

Continued on Next Page

2.

Car crashes occur according to a Poisson process at a rate of 2 per hour. There have been 12 crashes between 9:00 AM and 10:00 AM. Given that it is now 10:00 AM, at what time do you expect the 13^{th} crash?

A. Before 10:05 AM
B. On or after 10:05 AM, but before 10:15 AM
C. On or after 10:15 AM, but before 10:25 AM
D. On or after 10:25 AM, but before 10:35 AM
E. On or after 10:35 AM

Continued on Next Page

3.

The number of hurricanes for State XYZ follows a Poisson process with a mean of 0.02 per month. The amount of damage caused by a hurricane follows a Pareto distribution with mean 5000 and variance 25000000. You have set the risk load to be 10% of the standard deviation of losses. If the hurricane season is 4 months long, how much is the risk load?

A. Less than 50
B. At least 50, but less than 150
C. At least 150, but less than 250
D. At least 250, but less than 350
E. At least 350

Continued on Next Page

4.

You are given the following information:

- $Y = X_1 + \ldots + X_n$ where n =100
- $X_1, \ldots, X_n$ is a random sample from a Gamma distribution with $\alpha = 4$ and θ unknown

Calculate the value, c, to produce an unbiased estimate of θ from c*Y.

A. Less than .0035
B. At least .0035, but less than .0045
C. At least .0045, but less than .0055
D. At least .0055, but less than .0065
E. At least .0065

Continued on Next Page

5.

X is a two-parameter Pareto random variable with parameters θ and α.

A random sample from this distribution produces the following four claims:

- $x_1 = 2{,}000$
- $x_2 = 17{,}000$
- $x_3 = 271{,}000$
- $x_4 = 10{,}000$

Find the Method of Moments estimate for α.

A. Less than 2
B. At least 2, but less than 3
C. At least 3, but less than 4
D. At least 4, but less than 5
E. At least 5

Continued on Next Page

6.

Waiting times at a bank follow an exponential distribution with a mean equal to θ. The first five people in line are observed to have had the following waiting times: 10, 5, 21, 10, 7.

- $\hat{\theta}_A$ = Maximum Likelihood Estimator of θ
- $\hat{\theta}_B$ = Method of Moments Estimator of θ

Calculate $\hat{\theta}_A - \hat{\theta}_B$

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

Continued on Next Page

7.

You are given the following information on a random sample:

- $Y = X_1 + \ldots + X_n$ where the sample size, n, is equal to 25 and the random variables are independent and identically distributed
- X_i has a Poisson distribution with parameter λ
- $H_0 : \lambda = 0.1$
- $H_1 : \lambda < 0.1$
- The critical region to reject H_0 is $Y \leq 3$

Calculate the significance level of the test.

A. Less than .50
B. At least .50, but less than .60
C. At least .60, but less than .70
D. At least .70, but less than .80
E. At least .80

Continued on Next Page

8.

You have been given the following information to compare two hypotheses using the Neyman-Pearson lemma:

- X_i follows an exponential distribution where f(x) = $\lambda \exp(-\lambda x)$, x>0
- $H_0 : \lambda = 1$
- $H_1 : \lambda = 2$
- The numerator of the likelihood ratio test will hold the results for H_0 and the denominator will hold the results H_1
- The test will be based on a random sample of size 100 with $\bar{X}$=1.5

Calculate the lower limit of the critical region value for the likelihood ratio test described above so that the significance level will be 5%.

A. Less than 1.1
B. At least 1.1, but less than 1.2
C. At least 1.2, but less than 1.3
D. At least 1.3, but less than 1.4
E. At least 1.4

Continued on Next Page

9.

A claim department has operated under the following assumptions about expected automobile claims:

- 50% of the claims are for cars
- 20% of the claims are for motorcycles
- 15% of the claims are for vans
- 15% of the claims are for trucks

Using the following set of data, calculate the Chi-Square statistic that would be used in testing the claim department's assumptions about expected claim counts.

	Claims
Cars	40
Motorcycles	24
Vans	17
Trucks	19
Total	100

A. Less than 2
B. At least 2, but less than 5
C. At least 5, but less than 9
D. At least 9, but less than 15
E. At least 15

Continued on Next Page

10.

You are given the following information from a random sample:

- X_i is from a Normal distribution with mean =1 and variance =2
- Sample size is 20
- S^2 is the unbiased sample variance

Calculate the critical value, c, which satisfies the equation $\Pr\{S^2 \leq c\} = .95$.

A. Less than 2.8
B. At least 2.8, but less than 2.9
C. At least 2.9, but less than 3.0
D. At least 3.0, but less than 3.1
E. At least 3.1

Continued on Next Page

11.

Given the following:

- A random sample, $X_1,\ldots,X_n$, where X_i is Normally distributed with mean = μ_1, variance = σ_1^2 and the sample size, n, is 12.
- A random sample, $Y_1,\ldots,Y_m$, where Y_i is Normally distributed with mean = μ_2, variance = σ_2^2 and the sample size, n, is 13.
- $H_0 : \sigma_2^2 = k * \sigma_1^2$
- $H_1 : \sigma_2^2 > k * \sigma_1^2$
- The test statistic is S_2^2 / S_1^2
- The critical region is 5.58 and $\alpha = .05$

Calculate k, the multiplier that links σ_2^2 to σ_1^2 in the null hypothesis.

A. Less than 1.2
B. At least 1.2, but less than 1.4
C. At least 1.4, but less than 1.6
D. At least 1.6, but less than 1.8
E. At least 1.8

Continued on Next Page

12.

Claim severity follows a single-parameter Pareto distribution with $\theta = 5{,}000$ and $\alpha = 1.2$.

- $X_1, X_2, \ldots, X_5$ represent a random sample of claims.
- $Y_1, Y_2, \ldots, Y_5$ are the order statistics associated with the random sample.

Calculate the probability that Y_5 is greater than \$25,000.

A. Less than 20%
B. At least 20%, but less than 30%
C. At least 30%, but less than 40%
D. At least 40%, but less than 50%
E. At least 50%

Continued on Next Page

13.

Given the following chart about call options on a particular dividend paying stock, which option has the highest value?

Option	Option Style	Time Until Expiration	Strike Price	Stock Price
A	European	1 year	50	42
B	American	1 year	50	42
C	European	2 years	50	42
D	American	2 years	50	42
E	American	2 years	55	42

A. Option A
B. Option B
C. Option C
D. Option D
E. Option E

Continued on Next Page

14.

Given the following information about a European call option on Stock Z:

- The call price is 5.50.
- The call has a strike price of 47.
- The call expires in two years.
- The current stock price is 45.
- The continuously compounded risk-free rate is 5%.
- Stock Z will pay a dividend of 1.50 in one year.

Calculate the price of a European put option on Stock Z with a strike price of 47 that expires in two years.

A. Less than 3.00
B. At least 3.00, but less than 3.50
C. At least 3.50, but less than 4.00
D. At least 4.00, but less than 4.50
E. At least 4.50

Continued on Next Page

15.

A nine-month dollar-denominated call option on euros with a strike price of $1.30 is valued at $0.06. A nine-month dollar-denominated put option on euros with the same strike price is valued at 0.18. The current exchange rate is $1.2 /euro and the continuously compounded risk-free rate on dollars is 7%. What is the continuously compounded risk-free rate on euros?

A. Less than 7.5%
B. At least 7.5%, but less than 8.5%
C. At least 8.5%, but less than 9.5%
D. At least 9.5%, but less than 10.5%
E. At least 10.5%

Continued on Next Page

16.

An investor has been quoted a price on European options on the same non-dividend paying stock. The stock is currently valued at 80 and the continuously compounded risk-free interest rate is 3%. The details of the options are:

	Option 1	Option 2
Type	Put	Call
Strike	82	82
Time to expiration	180 days	180 days

Based on his analysis, the investor has decided that the prices of the two options do not present any arbitrage opportunities. He decides to buy 100 calls and sell 100 puts.

Calculate the net cost of this transaction.
(Hint: A positive net cost means the investor pays money from the transaction. A negative cost means the investor receives money.)

A. Less than -60
B. At least -60, but less than -20
C. At least -20, but less than 20
D. At least 20, but less than 60
E. At least 60

Continued on Next Page

17.

You are given the following information:

- A particular stock is currently worth 100.
- In one year, that stock will be worth either 120 or 90.
- The risk-free rate is 5% compounded continuously.

Calculate the delta for a call option that expires in one year with a strike price of 105.

A. Less than 0.20
B. At least 0.20, but less than 0.40
C. At least 0.40, but less than 0.60
D. At least 0.60, but less than 0.80
E. At least 0.80

Continued on Next Page

18.

You are given the following information about American options on a stock:

- The current stock price is 72.
- The strike price of the options is 80.
- The continuously-compounded risk-free rate is 5%.
- Time to expiration is 1 year.
- Every six months, the stock price either increases by 25% or decreases by 15%.

Using a two period binomial tree, calculate the price of an American put option.

A. Less than 8
B. At least 8, but less than 9
C. At least 9, but less than 10
D. At least 10, but less than 11
E. At least 11

Continued on Next Page

19.

A three month European call is modeled by a single period binomial tree using the following parameters:

- Continuously compounded risk-free rate = 4%
- Dividend = 0
- Annual volatility = 15%
- Current stock price = 10
- Strike price = 10.5

Calculate the value of the call option.

A. Less than 0.15
B. At least 0.15, but less than 0.30
C. At least 0.30, but less than 0.45
D. At least 0.45, but less than 0.60
E. At least 0.60

Continued on Next Page

20.

Which one of the following is an assumption of the Black-Scholes option pricing model?

A. Stock prices are normally distributed.
B. Stock price volatility is a constant.
C. Changes in stock price are log-normally distributed.
D. All transaction costs are included in stock returns.
E. The risk-free interest rate is a random variable.

Continued on Next Page

21.

On January 1st, 2007, the following currency information is given:

- Spot exchange rate = \$0.82/euro
- Dollar interest rate = 5.0% compounded continuously
- Euro interest rate = 2.5% compounded continuously
- Exchange rate volatility = 0.10

What is the price of 850 dollar-denominated euro call options with a strike exchange rate of \$0.80/euro that expire on January 1st, 2008?

A. Less than \$1.
B. At least \$10, but less than \$20
C. At least \$20, but less than \$30
D. At least \$30, but less than \$40
E. At least 40

Continued on Next Page

22.

A call option is modeled using the Black-Scholes formula with the following parameters.

- $S = 25$
- $K = 24$
- $r = 4\%$
- $\delta = 0\%$
- $\sigma = 20\%$
- $T = 1$

Calculate the call option elasticity, Ω.

A. Less than 5
B. At least 5, but less than 6
C. At least 6, but less than 7
D. At least 7, but less than 8
E. At least 8

Continued on Next Page

23.

A one-year European call option is currently valued at 0.9645. The following parameters are given.

- Current stock price = 10
- Continuously compounded risk-free rate = 6%
- Continuously compounded dividend rate = 1%
- Strike price = 10

Using a single period binomial tree, calculate the implied volatility of the stock, assuming that it is greater than 5%.

A. Less than 0.10
B. At least 0.10, but less than 0.20
C. At least 0.20, but less than 0.30
D. At least 0.30, but less than 0.40
E. At least 0.40

Continued on Next Page

24.

An investor has a portfolio consisting of 100 put options on stock A, with a strike price of 40, and 5 shares of stock A. The investor can write put options on stock A with a strike price of 35. The deltas and gammas of the options are listed below:

	Put (Strike = 35)	Put (Strike = 40)
Delta	-0.10	-0.05
Gamma	0.50	0.25

Which one of the following actions would delta and gamma neutralize this portfolio?

A. Write 100 put options with a strike price of 35.
B. Write 50 put options with a strike price of 35.
C. Write 100 put options with a strike price of 35, and buy 5 shares of stock.
D. Write 100 put options with a strike price of 35, and sell 5 shares of stock.
E. Write 50 put options with a strike price of 35, and sell 5 shares of stock.

Continued on Next Page

25.

On January 1, 2007, the Florida Property Company purchases a one-year property insurance policy with a deductible of $50,000. In the event of a hurricane, the insurance company will pay the Florida Property Company for losses in excess of the deductible. Payment occurs on December 31, 2007. For the last three months of 2007, there is a 20% chance that a single hurricane occurs and an 80% chance that no hurricane occurs. If a hurricane occurs, then the Florida Property Company will experience $1,000,000 in losses. The continuously compounded risk-free rate is 5%.

On October 1, 2007, what is the risk-neutral expected value of the insurance policy to the Florida Property Company?

A. Less than $185,000
B. At least $185,000, but less than $190,000
C. At least $190,000, but less than $195,000
D. At least $195,000, but less than $200,000
E. At least $200,000

Continued on Next Page

26.

Which one of the following statements is true about exotic options?

A. Asian options are worth more than European options.
B. Barrier options have a lower premium than standard options.
C. Gap options can not be priced with the Black-Scholes formula.
D. Compound options can be priced with the Black-Scholes formula.
E. Asian options are path-independent options.

Continued on Next Page

27.

At the beginning of the year, a speculator purchases a six-month geometric average price call option on a company's stock. The strike price is 3.5. The payoff is based on an evaluation of the stock price at each month's end.

Date	Stock Price
January 31	1.27
February 28	4.11
March 31	5.10
April 30	5.50
May 31	5.13
June 30	4.70

Based on the above stock prices, calculate the payoff of the option.

A. Less than .3
B. At least .3, but less than .75
C. At least .75, but less than 1.00
D. At least 1.00, but less than 1.75
E. At least 1.75

Continued on Next Page

28.

You are given the following information on a compound CallOnPut option:

- The continuously compounded risk-free rate is 5%.
- The strike price of the underlying option is 43.
- The strike price of the compound option is 3.
- The compound option expires in 6 months.
- The underlying option expires 6 months after the compound option.
- The underlying option is American.

Today	6 months	12 months
		$S_{HH} = 64.52$
	$S_H = 50.80$	
$S_0 = 40.00$		$S_{HL} = 42.16$
	$S_L = 33.20$	
		$S_{LL} = 27.56$

Based on the above binomial stock price tree, calculate the value of the compound option.

A. Less than 3.00
B. At least 3.00, but less than 3.50
C. At least 3.50, but less than 4.00
D. At least 4.00, but less than 4.50
E. At least 4.50

Continued on Next Page

29.

An investor is deciding whether to buy a given stock, or European call options on the stock. The value of the call option is modeled using the Black-Scholes formula and the following assumptions:

- Continuously compounded risk-free rate = 4%
- Continuously compounded dividend = 0
- Expected return on stock = 8%
- Current stock price = 37
- Strike price of call option = 41
- Estimated stock volatility = 25%
- Time to expiration = 1 year

Calculate the Sharpe ratio of the option.

A. Less than 0.10
B. At least 0.10, but less than 0.20
C. At least 0.20, but less than 0.30
D. At least 0.30, but less than 0.40
E. At least 0.40

Continued on Next Page

30.

Survival follows a Weibull distribution. Given the following:

- $\mu(x) = kx^2$, $k>0$, $x \geq 0$ defines the hazard rate function
- ${}_3q_2 = 0.68963$

Calculate ${}_{2|}q_2$.

A. Less than 0.240
B. At least 0.240, but less than 0.250
C. At least 0.250, but less than 0.260
D. At least 0.260, but less than 0.270
E. At least 0.270

Continued on Next Page

31.

You are given:

- ${}_{x}p_{0}$ = 0.75
- $s(x + u)$ = 0.70
- ${}_{u|v}q_{x}$ = 0.04

Calculate $s(x + u + v)$.

A. Less than 0.665
B. At least 0.665, but less than 0.675
C. At least 0.675, but less than 0.685
D. At least 0.685, but less than 0.695
E. At least 0.695

Continued on Next Page

32.

You are given the following life table:

x	ℓ_x
45	1,000
46	900
47	700

Deaths are uniformly distributed within each year of age.

Calculate ${}_{0.5}p_{45.75}$.

A. Less than 0.92
B. At least 0.92, but less than 0.93
C. At least 0.93, but less than 0.94
D. At least 0.94, but less than 0.95
E. At least 0.95

Continued on Next Page

33.

For two independent lives (x) and (y), you are given:

- ${}_{k|}q_x = 0.2$; $k = 0, 1, 2, 3, 4$
- $q_{y+k} = (0.3)^{k+1}$; $k = 0, 1, 2, 3, 4$

Calculate $\overline{e}_{\overline{xy}:\overline{2}|}$, the temporary curtate expectation for the last survivor status.

A. Less than 1.81
B. At least 1.81, but less than 1.84
C. At least 1.84, but less than 1.87
D. At least 1.87, but less than 1.90
E. At least 1.90

Continued on Next Page

34.

A communications device uses two non-rechargeable, non-replaceable batteries, each with

${}_t p_0 = 1 - 0.01t$ for $t < 100$,

${}_t p_0 = 0$ elsewhere.

(Note: t measured in years)

Currently, failure of one of the batteries results in device failure. However, the device has recently been re-configured so that the device can still operate as long as one of the two batteries is operational. How much will the average life of the device improve?

A. Less than 20 years
B. At least 20 years, but less than 25 years
C. At least 25 years, but less than 30 years
D. At least 30 years, but less than 35 years
E. At least 35 years

Continued on Next Page

35.

You are given the following life table:

x	$q_x^{(1)}$	$q_x^{(2)}$	$\ell_x^{(\tau)}$
55	0.01	0.03	1,000
56	0.02	0.04	
57	0.03	0.05	
58	0.04	0.06	

Calculate $\ell_{57}^{(\tau)}$.

A. Less than 900
B. At least 900, but less than 901
C. At least 901, but less than 902
D. At least 902, but less than 903
E. At least 903

Continued on Next Page

36.

Drivers are classified as either Preferred or Standard and are reclassified at the end of each year according to a homogeneous Markov process. The probability of a driver who is classified as Preferred at T = 0 being classified as Preferred at T = 1 is 80%. The probability of a driver who is classified as Standard at T = 0 being classified as Standard at T = 2 is 44%.

Calculate the probability of a driver classified as Standard at T = 0 being classified as Preferred at T = 1.

A. Less than .35
B. At least .35, but less than .45
C. At least .45, but less than .55
D. At least .55, but less than .65
E. At least .65

Continued on Next Page

37.

For a discrete two-year term life insurance of unit benefit on (50), you are given:

- ${}_2E_{50} = 0.840$
- $p_{50} = 0.960$
- ${}_{1|}q_{50} = 0.080$

Calculate the present value of the benefit payment of the term life insurance.

A. Less than 0.112
B. At least 0.112, but less than 0.113
C. At least 0.113, but less than 0.114
D. At least 0.114, but less than 0.115
E. At least 0.115

Continued on Next Page

38.

You are given the following actuarial present values:

- ${}_nE_x = 0.75$
- $\overline{a}_x = 1.20$
- $\overline{a}_{x+n} = 1.10$

Calculate $\overline{a}_{x:\overline{n}|}$, the value of an n-year continuous temporary life annuity.

A. Less than 0.05
B. At least 0.05, but less than 0.15
C. At least 0.15, but less than 0.25
D. At least 0.25, but less than 0.35
E. At least 0.35

Continued on Next Page

39.

You are calculating reserves for a life insurance policy that has a death benefit of \$100 and an annual premium of \$3.50. You are given:

- $v = 0.96$
- $\ddot{a}_{20:\overline{10}|} = 7.4$
- $p_{20} = 0.98$
- ${}_{10}p_{20} = 0.66$

Find ${}_1V_{20:\overline{10}|}$.

A. Less than -\$0.50
B. At least -\$0.50 but less than \$0.50
C. At least \$0.50, but less than \$1.50
D. At least \$1.50, but less than \$2.50
E. At least \$2.50

Continued on Next Page

40.

For states numbered 1, 2 and 3, you are given the following:

- The transition probability matrix for a homogeneous Markov Chain,

$$Q = \begin{bmatrix} 0.6 & 0.4 & 0.0 \\ 0.1 & 0.7 & 0.2 \\ 0 & 0 & 1 \end{bmatrix}$$

- Transition cash flow matrix (paid at the end of each time step),

$$C = \begin{bmatrix} 0 & 70 & 0 \\ 30 & 0 & 100 \\ 0 & 0 & 0 \end{bmatrix}$$

- $i = 10\%$

Calculate the actuarial present value of the cash flows of an entity starting in State 1 over two time steps.

A. Less than 45
B. At least 45, but less than 46
C. At least 46, but less than 47
D. At least 47, but less than 48
E. At least 48

End of Examination

Fall 2007 Exam 3 Answer Key

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