Instructions.
1. Please turn off your CELL PHONES and place them under your chair. Any student caught with mobile phones on during the exam will be considered under the cheating rules of the University.
2. If you need to leave the room, please do so quietly so not to disturb others taking the test. No two person can leave the room at the same time. **No extra time** will be provided for the time missed outside the classroom.
3. Only materials provided by the instructor can be present on the table during the exam.
4. Do not spend too much time on any one question. If a question seems too difficult, leave it and go on.
5. Use the blank portions of each page for your work. Extra blank pages can be provided if necessary. If you use an extra page, indicate clearly what problem you are working on.
6. Only answers supported by work will be considered. Unsupported guesses will not be graded.
7. While every attempt is made to avoid defective questions, sometimes they do occur. In the rare event that you believe a question is defective, the instructor cannot give you any guidance beyond these instructions.
8. Mobile calculators or communicable devices are disallowed. Use SOA Approved Financial or scientific calculator only. Write important steps to arrive at the solution of the following problems.

The test is 90 minutes, GOOD LUCK, and you may begin now!
Extra blank page
1. (1+4=5 marks) A company insures homes in three cities, J, K and L. Since sufficient distance separates
the cities, it is reasonable to assume that the losses occurring in these cities are independent. The
moment generating functions for the loss distributions of the cities are:

\[ M_J(t) = (1 - 2t)^{-3}, \quad M_K(t) = (1 - 2t)^{-2.5}, \quad M_L(t) = (1 - 2t)^{-4.5} \]

Let \( X \) represent the combined losses from the cities. Calculate \( E(X^3) \).

a) 1320 

b) 2082 

c) 5760 

d) 8000 

e) 10560 

Work Shown (4 points)

The answer is ___.

2. (1+4=5 marks) An actuary uses the following distribution for the random variable \( T \), time until death,
for a new born baby: 

\[ f(t) = \frac{t}{5000} \text{ for } 0 < t < 1000 \]

At the time of birth, an insurance policy is set up to pay an amount of \((1.1)^t\) at time \( t \) if death occurs at that instant. Find the expected payout on
this insurance policy. (nearest 100)

a) 2000 

b) 2200 

c) 2400 

d) 2600 

e) 2800 

Work Shown (4 points)

The answer is ___.
3. (1+4=5 marks) A random variable has the cumulative distribution function

\[ F(x) = \begin{cases} 
0 & \text{for } x < 1 \\
\frac{x^2 - 2x + 2}{2} & \text{for } 1 \leq x < 2 \\
1 & \text{for } x \geq 2 
\end{cases} \]

Calculate the variance of \( X \).

a) \( \frac{7}{72} \)

b) \( \frac{1}{8} \)

c) \( \frac{5}{36} \)

d) \( \frac{4}{32} \)

e) \( \frac{23}{12} \)

Work Shown (4 points)

4. (1+4=5 marks) The probability that a particular machine breaks down in any day is 0.20 and is independent of the breakdowns on any other day. The machine can break down only once per day. Calculate the probability that the machine breaks down two or more times in ten days.

a) 0.9596

b) 0.6242

c) 0.2684

d) 0.0400

e) 0.1075

Work Shown (4 points)

The answer is .
5. (1+4=5 marks) An actuary has discovered that policyholders are three times as likely to file two claims as to file four claims. If the number of claims filed as Poisson distribution, what is the variance of the number of claims filed?

a) \( \frac{1}{\sqrt{3}} \)

b) 1

c) \( \sqrt{2} \)

d) 2

e) 4

Work Shown (4 points)

The answer is .

6. (1+4=5 marks) An insurance policy on an electrical device pays a benefit of 4000 if the device fails during the first year. The amount of the benefit decreases by 1000 each successive year until it reaches 0. If the device has not failed by the beginning of any given year, the probability of failure during that year is 0.4. What is the expected benefit under this policy?

a) 2694

b) 2667

c) 2500

d) 2400

e) 2234

Work Shown (4 points)

The answer is .
7. (1+4=5 marks) A box contain 10 white and 15 black marbles. Let $X$ denote the number of white marbles in a selection of 10 marbles selected at random and without replacement. Find $\frac{\text{Var}[X]}{E[X]}$.

a) $\frac{1}{8}$

b) $\frac{3}{16}$

c) $\frac{2}{8}$

d) $\frac{5}{16}$

e) $\frac{3}{8}$

Work Shown (4 points)

The answer is .

8. (1+4=5 marks) Two instruments are used to measure the height, $h$, of a tower. The error made by the less accurate instrument is normally distributed with mean 0 and standard deviation $0.0056h$. The error made by the more accurate instrument is normally distributed with mean 0 and standard deviation $0.0044h$. Assuming the two measurements are independent random variables, what is the probability that their average value is within 0.005$h$ of the height of the tower?

a) 0.38

b) 0.68

c) 0.84

d) 0.92

e) 0.98

Work Shown (4 points)

The answer is .
9. (1+4=5 marks) The time to failure of a component in an electronic device has an exponential distribution with a median of four hours. Calculate the probability that the component will work without failing for at least five hours.

a) 0.07
b) 0.29
c) 0.38
d) 0.42
e) 0.57

Work Shown (4 points)

The answer is .

10. (1+4=5 marks) Average loss size per policy on a portfolio of policies is 100. Actuary 1 assumes that the distribution of loss size has an exponential distribution with a mean of 100, and Actuary 2 assumes that the distribution of loss size has a pdf of $f_2(x) = \frac{2\theta^2}{(x+\theta)^3}$, $x > 0$. If $m_1$ and $m_2$ represent the median loss sizes for the two distributions, find $\frac{m_1}{m_2}$.

a) 2.0
b) 1.7
c) 1.3
d) 1.0
e) 0.6

Work Shown (4 points)

The answer is .

END OF TEST PAPER