**CS215 SAFE Quiz 4** **11 September 2024**

1. Let $X$ be a Poisson random variable with parameter $\lambda$. Given $E[X] = 13.4$, find the largest value of $k$ such that

$$\frac{P(X = k)}{P(X = k - 1)} \geq 1$$

is:

(a) 12

(b) 13

(c) 13.4

(d) 14

**Answer: (b)**

2. In response to an attack of 10 missiles, 500 anti-ballistic missiles are launched. The missile targets of the anti-ballistic missiles are independent, and each anti-ballistic missile is equally likely to go towards any of the target missiles. If each anti-ballistic missile independently hits its target with probability $\frac{ln(2)}{50}$, use the Poisson paradigm to approximate the probability that all missiles are hit. If the answer is of the form $\frac{1}{a}$, enter $a$.

**Answer: 1024**

3. Let $X$ be a discrete Random Variable with Moment Generating Function $\phi(t)$ given by

$$\phi(t) = \frac{1}{7}e^{2t} + \frac{3}{7}e^{3t} + \frac{2}{7}e^{5t} + \frac{1}{7}e^{8t}$$

Then $E[X] =$

(a) $\frac{29}{7}$

(b) $\frac{23}{7}$

(c) 1

(d) $\frac{145}{7}$

**Answer: (a)**

4. Suppose the Moment Generating Function $\phi(t)$ of a Discrete Random Variable $X$ ($x \in \{0, 1, 2...\}$) is

$$\phi(t) = e^{3(e^t - 1}$$

Which of the following statements are is/are correct regarding $X$?

(a) $X = 2$ is a mode of the PMF

(b) The PMF has a unique mode

(c) $E[X] = 3$

(d) $P(X = 0) = e^{-3}$

**Answer: (a), (c), (d)**

5. You need to sample values from a Normal distribution with mean $\mu = 3$ and variance $\sigma^2 = 9$. However, you can only sample from the standard Normal distribution $Z \sim \mathcal{N}(0, 1)$, and you have access to a linear transformation layer that computes $Y = aZ + b$. What should the values of $a$ and $b$ be to obtain samples $Y$ from the desired Normal distribution $\mathcal{N}(3, 9)$?

(a) $a = 3$

(b) $a = 9$

(c) $b = 3$

(d) $b = 9$

**Answer: (a), (c)**