1. **Raindrops are falling at an average rate of 20 drops per square inch per minute. What would**

**be a reasonable distribution to use for the number of raindrops hitting a particular region**

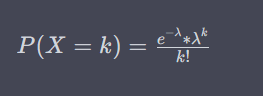
**measuring 5 inches2 in t minutes? Why? Using your chosen distribution, compute the**

**probability that the region has no rain drops in a given 3 second time interval. A reasonable**

**choice of distribution is P**

**n this scenario, we can use the Poisson distribution to model the number of raindrops hitting a particular region. The Poisson distribution is appropriate when events occur randomly at a constant average rate over time or space, and events are independent.**

**The Poisson distribution is defined by a single parameter λ (lambda), which represents the average rate of events in a fixed interval. In this case, λ is the rate of raindrops per square inch per minute. The probability mass function (PMF) of the Poisson distribution is given by:**



**P(X=k) is the probability of observing exactly k raindrops.**

**e is the base of the natural logarithm (approximately 2.71828).**

**λ is the average rate of raindrops (20 drops per square inch per minute).**

**k is the number of raindrops we want to calculate the probability for.**

**k! is the factorial of k.**

**To find the probability that the region has no raindrops in a 3-second time interval, we need to convert the rate from "drops per square inch per minute" to "drops per square inch per 3 seconds" by dividing λ by 20 (since 1 minute = 60 seconds). So, λ for a 3-second interval is:**

**=**

**So, the probability that the region has no raindrops in a given 3-second time interval is approximately 0.3679.**

2. Let X be a random day of the week, coded so that Monday is 1, Tuesday is 2, etc. (so X takes

values 1, 2,..., 7, with equal probabilities). Let Y be the next day after X (again represented as

an integer between 1 and 7). Do X and Y have the same distribution? What is P(X)

**For X, the random day of the week, we have 7 possible outcomes (1 through 7, representing Monday through Sunday) with equal probabilities.**

**For Y, the next day after X, we can calculate its distribution by considering the following:**

**If X is any day from Monday (1) through Saturday (6), Y will be the next day, which is X + 1.**

**If X is Sunday (7), Y will be Monday (1).**

**So, Y takes values 1 through 7, with unequal probabilities:**

**\frac{1}{7} & \text{if } y \text{ is in } \{1, 2, 3, 4, 5, 6\} \\**

**\frac{1}{7} + \frac{1}{7} & \text{if } y = 7**

**\end{cases}\]**

**In other words, Y has a uniform distribution over the days of the week (1 through 7) with equal probabilities, except for Sunday (7), which has double the probability.**

**The probability \(P(X)\) that a random day is any particular day (e.g., Monday) is 1/7 since all days have equal probabilities.**