

Poisson Probability Distribution

Given that X is a Poisson random variable. Find the probability of getting exactly x occurrences.

$$P(x) = \frac{\mu^x \cdot e^{-\mu}}{x!}$$

Where e is the natural number, $e \approx 2.71828$ and μ = mean number of occurrences of the event in the interval.

Practice: (Use the above formula)

1. Calculate $\frac{5^3 \cdot e^{-5}}{3!}$

2. Assume Poisson Probability Distribution with mean of 5.6. Use the formula to find the probability of getting exactly 8 occurrence. That is, find $P(8)$.

TI Calculator Steps:

1. Press **2nd** then, **VARs** keys to access the DISTR (distributions) menu.
2. Select **poissonpdf** and click **ENTER**.
3. Enter the values for λ (which is the mean), and x value to complete the command **poissonpdf(μ , x)**. Press **ENTER**.

Note:

poissonpdf(μ , x). calculate $P(x)$, probability of getting exactly x success.

poissoncdf(μ , x). calculate $P(\text{at most } x)$, probability of getting at most x success.

If you want to calculate $P(\text{at least } x)$, use the complement since there is no upper limit for x value. That is, **$P(\text{at least } x) = 1 - P(\text{at most } (x-1))$** .

Example: The average number of TI calculator sold on Amazon is 3.5 per hour.

- a. Find the probability that in a given hour, Amazon will sell exactly 3 TI calculators.

$$P(\text{Exactly } 3) = P(x = 3) = \text{poissonpdf}(3.5, 3) = 0.216$$

- b. Find the probability that in a given hour, Amazon will sell at most 1 TI calculator.

$$P(\text{at most } 1) = P(x \leq 1) = \text{poissoncdf}(3.5, 1) = 0.136$$

- c. Find the probability that in a given hour, Amazon will sell at least 2 TI calculator.

$$P(\text{at least } 2) = 1 - P(\text{at most } 1) = 1 - P(x \leq 1) = 1 - \text{poissoncdf}(3.5, 1) = 0.864$$

Practice:

3. The mean number of students come to the Math Lab is 1.25 per minute. Assume this is a Poisson random variable.
 - a. Find the probability that no students come into the Math Lab for a given minute.
 - b. Find the probability that for a given minute, at most 3 students come to the Math Lab.
 - c. Find the probability that for a given minute, at least 2 students come to the Math Lab.

Answers to practice problems:

1. 0.140
2. 0.0887
3. a. 0.287
b. 0.962
c. 0.355