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(at most x), probability of getting at most x success.
If you want to calculate P(at least x), use the complement since there is no upper limit for x value. That is, **P(at least x) = 1 – P(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(Exactly 3) = P(x = 3) = poissonpdf(3.5, 3) = 0.216

b. Find the probability that in a given hour, Amazon will sell at most 1 TI calculator.
   P(at most 1) = $P(x \leq 1)$= poissoncdf(3.5, 1) = 0.136

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

   P(at least 2) = 1 – P(at most 1) = 1 - $P(x \leq 1)$ = 1 – 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