

**Topic:** Poisson distributions

**Question:** A carpenter is able to build 3 chairs per day, on average. Find the probability that he can build 5 chairs tomorrow.

**Answer choices:**

A  $P(5) \approx 0.1008$

B  $P(5) \approx 0.1404$

C  $P(5) \approx 0.0136$

D  $P(5) \approx 0.2729$



**Solution: A**

We know this is a Poisson experiment with the following given values:

$\lambda = 3$ , the average number of chairs built in a day

$x = 5$ , the number of chairs required to be built tomorrow

The Poisson probability is

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

$$P(5) = \frac{3^5 e^{-3}}{5!}$$

$$P(5) \approx 0.1008$$

So the probability the carpenter will build five chairs tomorrow is approximately 0.1008 or 10.08 %.



**Topic:** Poisson distributions

**Question:** Let  $X$  be the number of typos on a page in a printed book, with a mean of 3 typos per page. What is the probability that a randomly selected page has at most one typo on it?

**Answer choices:**

- A  $P(X \leq 1) \approx 0.0498$
- B  $P(X \leq 1) \approx 0.1404$
- C  $P(X \leq 1) \approx 0.1494$
- D  $P(X \leq 1) \approx 0.1991$



**Solution: D**

The probability that there is at most one typo on the page is the probability that there are no typos on the page ( $X = 0$ ), plus the probability that there is one typo on the page ( $X = 1$ ).

$$P(X \leq 1) = P(X = 0) + P(X = 1)$$

$$P(X \leq 1) = \frac{3^0 e^{-3}}{0!} + \frac{3^1 e^{-3}}{1!}$$

$$P(X \leq 1) = e^{-3} + 3e^{-3}$$

$$P(X \leq 1) = 4e^{-3}$$

$$P(X \leq 1) \approx 0.1991$$

There is an approximately 0.1991 or 19.91 % chance of finding at most one typo on a randomly selected page, when the average number of typos per page is 3.



**Topic:** Poisson distributions

**Question:** There are 40 students in a college math course, and each one of them has a 4.5 % chance of forgetting their calculator on any given day. What is the probability that exactly 5 of them will forget their calculator today?

**Answer choices:**

- A       $P(5) \approx 95.26 \%$
- B       $P(5) \approx 97.4 \%$
- C       $P(5) \approx 2.6 \%$
- D       $P(5) \approx 36.97 \%$



**Solution: C**

This is a binomial experiment with  $n = 40$ ,  $p = 0.045$ , and  $x = 5$ . Because we have at least 20 “attempts,” and because the probability of a “success” is less than 5 %, we can use the Poisson formula to estimate this binomial probability.

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

$$P(5) = \frac{(40 \cdot 0.045)^5 e^{-40 \cdot 0.045}}{5!}$$

$$P(5) = \frac{1.8^5 e^{-1.8}}{120}$$

$$P(5) \approx 0.0260$$

So the chance that exactly 5 of the college math students forget their calculator today is approximately 2.6 %.

