Abdullah Gul University

Math-301 (Probability & Statistics)

Fall 2022, QUIZ - VIII

Name & Surname:
ID Number:

Q 1. (100 pt.)

In real life, unfortunately, some errors in software cannot be noticed before the sale. Suppose that the mean value for the number of errors in a piece of software is 3 after the sale. Then, **a-)** considering the number (from zero to 10) of errors that can be found in the software as a random variable, draw the histogram for the probability distribution values of these variables, and **b-)** calculate the mean and standard deviation for the histogram.

Formulas:

$$\mathrm{b(x, n, p)} = \frac{n!}{x!\,(n-x)!}(p)^x(q)^{n-x}$$

$$b^{-}(k, x, p) = \frac{(x-1)!}{(x-k)!\,(k-1)!}(p)^k(q)^{x-k}$$

$$g(x, p) = p(q)^{x-1}$$

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

$$\mu = E[x] = \sum_{i}^{n} x_i f(x_i)$$

$$Var(X) = E[(X-\mu)^2]$$

SOLUTION:

a-)

We have two independent results:

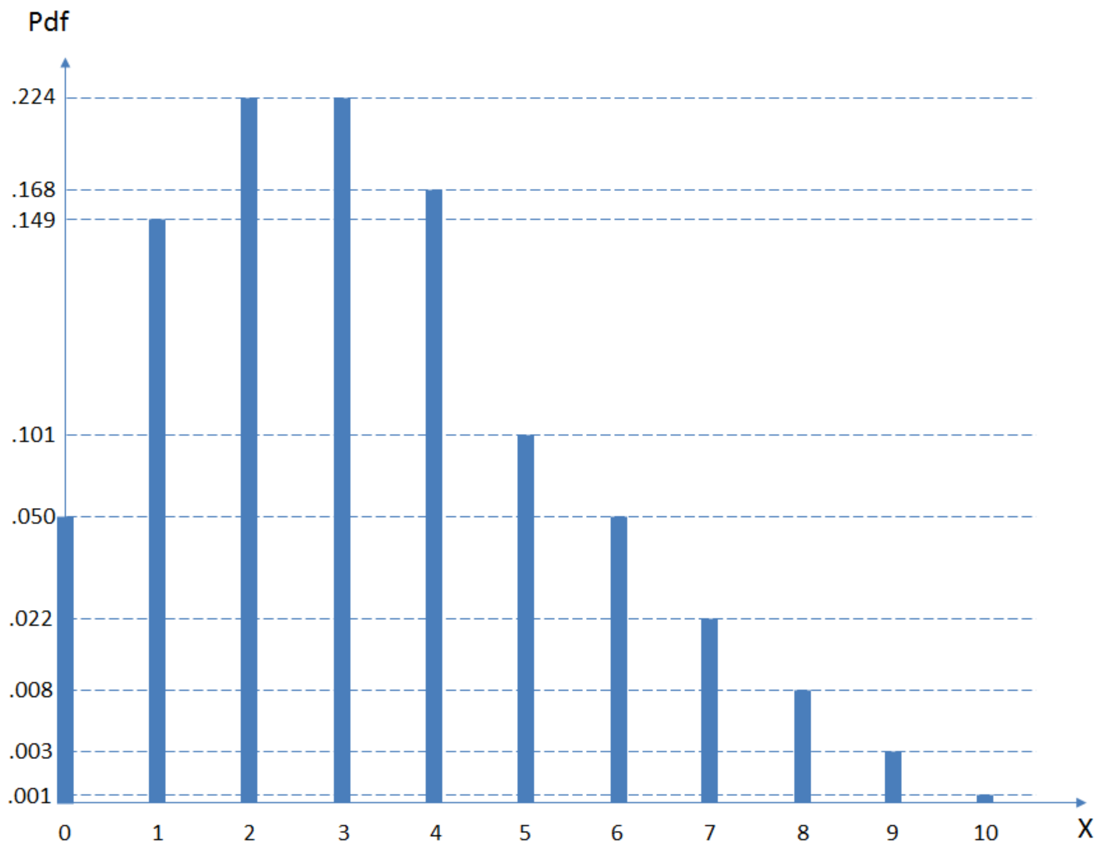
Success: To have error
Failure: Not to have error

In the question, we have only the information about the mean number of errors in the software. Then, we can use the Poisson distribution formula.

We should calculate the pdf value for each of the random variable changes from 0 to 10;
The pdf values are p(0,3), p(1,3), p(2,3), p(3,3), p(4,3), p(5,3), p(6,3), p(7,3), p(8,3), p(9,3), and p(10,3).

$$p(0,3) = \frac{2.718^{-3}3^{0}}{0!} \approx 0.050$$
$$p(1,3) = \frac{2.718^{-3}3^{1}}{1!} \approx 0.149$$
$$p(2,3) = \frac{2.718^{-3}3^{2}}{2!} \approx 0.224$$
$$p(3,3) = \frac{2.718^{-3}3^{3}}{3!} \approx 0.224$$
$$p(4,3) = \frac{2.718^{-3}3^{4}}{4!} \approx 0.168$$
$$p(5,3) = \frac{2.718^{-3}3^{5}}{5!} \approx 0.101$$
$$p(6,3) = \frac{2.718^{-3}3^{6}}{6!} \approx 0.050$$
$$p(7,3) = \frac{2.718^{-3}3^{7}}{7!} \approx 0.022$$
$$p(8,3) = \frac{2.718^{-3}3^{8}}{8!} \approx 0.008$$
$$p(9,3) = \frac{2.718^{-3}3^{9}}{9!} \approx 0.003$$
$$p(10,3) = \frac{2.718^{-3}3^{10}}{10!} \approx 0.001$$

To draw the pdf function:



b-)

$$\mu = E[x] = \sum_{i=0}^{n=10} x_i f(x_i)$$

$$= (0)(0.050) + (1)(0.149) + (2)(0.224) + (3)(0.224) + (4)(0.168) + (5)(0.101) + (6)(0.050) + (7)(0.022) + (8)(0.008) + (9)(0.003) + (10)(0.001) = 3.001 \approx 3 = \mu$$

$$Var(X) = E[(X-\mu)^2] = E[X^2] - 2\mu E[X] + E[\mu^2] = E[X^2] - 2\mu\mu + \mu^2 = E[X^2] - \mu^2$$

$$E[X^2] = \sum_{i=0}^{n=10} (X_i)^2 f(X_i)$$

$$= 0^2 f(0) + 1^2 f(1) + 2^2 f(2) + 3^2 f(3) + 4^2 f(4) + 5^2 f(5) + 6^2 f(6) + 7^2 f(7) + 8^2 f(8) + 9^2 f(9) + 10^2 f(10) = 12.007$$

$$\sigma^2 = Var(X) = 12.007 - (3)^2 = 3.001$$

$$\sigma = \sqrt{\sigma^2} = \sqrt{3.001} \approx 1.73$$