A random variable X, taking values in the non-negative integers, has a Poisson (λ) distribution if

$$P(X=x|\lambda) = \frac{e^{-\lambda}\lambda^{x}}{x!}, \quad x=0,1,\ldots$$

$$x! = x(x-1)(x-2)\cdots 1$$

ex. $4! = 4\times 3\times 2\times 1 = 24$

$EX = \lambda = \operatorname{Var} X$

Ex. As an example of waiting-for-occurrence application, consider a telephone operator who, on the average, handles 5 calls every 3 minutes. What is the probability that there will be no calls in the next minute? Atleast 2 calls?

Let X = # of calls in a minute.
then $X \sim \text{Poisson}(5/3)$. so $EX = VX = \frac{5}{3}$.

P(0 calls in the next minute)

$$= P(x=0)$$

$$= \frac{e^{-5/3}(5/3)^0}{0!}$$

$$= e^{-5/3}$$

$$= 18.9\%$$

P(at least 2 calls in the next min)

$$= P(x \geqslant 2)$$

$$= 1 - P(x \leq 1)$$

$$= 1 - P(x=0) - P(x=1)$$

$$= 1 - .189 - \frac{e^{-5/3}(5/3)^1}{1!}$$

$$= 49.6\%$$