Q1. (2+3 =5 points) The safety supervisor at a large manufacturing plant believes that the number of industrial accidents per month $Y$ follows the Poisson distribution of the parameter 3.

a) What is the probability of exactly two accidents occurring next month?

\[ P(X = 2) = e^{-3} \frac{3^2}{2!} = 0.224041807 \]

b) What is the probability of at least two accidents occurring in the next three months?

\[ P(X \geq 2) = 1 - P(X < 2) = 1 - P(X \leq 1) \]

\[ = 1 - (e^{-9} \frac{9^0}{0!} + e^{-9} \frac{9^1}{1!}) = 1 - 0.00123409804 = 0.998765902 \]

Q2. (3+2 =5 points) A sample of 4 water bottles is taken in a river near a large city to determine $X$, the number containing pollution. Suppose that 10 percent of the city's river contains pollution.

i. What is the probability that at least two bottles selected contain pollution?

\[ P(X \geq 2) = P(X = 2) + P(X = 3) + P(X = 4) \]

\[ = \binom{4}{2} (0.1)^2 (0.9)^2 + \binom{4}{3} (0.1)^3 (0.9)^1 + (0.1)^4 \]

\[ = 0.024 + 0.0081 + 0.001 = 0.0331 \]

ii. What is the standard deviation of the number of bottles selected contain pollution?

\[ \text{Var}(X) = npq = 4 \times 0.1 \times 0.9 = 0.36 \]

\[ SD(X) = \sqrt{\text{Var}(X)} = \sqrt{0.36} = 0.6 \]
Q1. (2+3 = 5 points) The safety supervisor at a large manufacturing plant believes that the number of industrial accidents per month $Y$ follows the Poisson distribution of the parameter 4.

a) What is the probability of exactly two accidents occurring next month?

b) What is the probability of at least two accidents occurring in the next two months?

Solution: a) $P(X = 2) = \frac{e^{-4}4^2}{2!} = 0.146525111$. 

b) $P(X \geq 2) = 1 - P(X < 2) = 1 - P(X \leq 1)$ only true for discrete distributions.

$$P(X \geq 2) = 1 - P(X < 2) = 1 - P(X \leq 1) = 1 - (e^{-8}8^0 + 8e^{-8}8^1) = 1 - 0.003019163651 = 0.996980836.$$ 

Q2. (3+2 = 5 points) A sample of 4 water bottles is taken in a river near a large city to determine $X$, the number containing pollution. Suppose that 36 percent of the city's river contains pollution.

i. What is the probability that at least two bottles selected contain pollution?

ii. What is the standard deviation of the number of bottles selected contain pollution?