

## Answer on Question #71186 – Math – Statistics and Probability

### Question

Suppose a biological cell contains 400 genes. When treated radioactivity the probability that a gene will change into mutant gene is 0.006 and is independent of the other genes. What is the approximate probability that there are at most four mutant genes after the treatment?

### Solution

In this case we have Binomial Distribution with the following parameters:

$$n = 400, p = 0.006, q = 1 - p = 0.994.$$

Let's apply the Poisson approximation

(see <https://onlinecourses.science.psu.edu/stat414/node/85>).

We shall get

$$\lambda = np = 2.4,$$

and the corresponding Poisson distribution is

$$P(\xi = k) = \frac{(2.4)^k}{k!} e^{-2.4}, k = 0, 1, \dots$$

(see [https://en.wikipedia.org/wiki/Poisson\\_distribution](https://en.wikipedia.org/wiki/Poisson_distribution)).

The required probability is

$$\begin{aligned} P(\xi \leq 4) &= P(\xi = 0) + P(\xi = 1) + P(\xi = 2) + P(\xi = 3) + P(\xi = 4) = \\ &= e^{-2.4} + 2.4e^{-2.4} + 2.88e^{-2.4} + 2.304e^{-2.4} + 1.3824e^{-2.4} = 9.9664e^{-2.4} \approx 0.904. \end{aligned}$$

**Answer:** 0.904.