Answer on Question #55482 – Math – Statistics and Probability

Question

Software filters rely heavily on "blacklists" (lists of known "phishing" URLs) to detect fraudulent e-mails. But such filters typically catch only 20 percent of phishing URLs. Jason receives 16 phishing e-mails.

What is the chance that such a filter would detect none of them?

Solution

Let us denote the probability of filter catching one phishing e-mail as p. One may see from the question that

$$p = 0.2.$$

Now, the probability of not catching a phishing e-mail is

$$q = 1 - p = 1 - 0.2 = 0.8$$

(because the events of catching and not catching phishing e-mail are independent, mutually exclusive and complementary, so $p + q = 1$).

Now, the probability of filter detecting none of e-mails is the probability of not detecting the first and not detecting the second and so on and so forth up to the not detecting the 16-th e-mails. Now, whether the k-th e-mail detected or not does not depend on whether the previous one was detected. So, these events are independent, hence probability of their simultaneous occurrence is just the product of their probabilities:

$$P(none\ detected) = \underbrace{q \cdot \ldots \cdot q}_{16\ times} = q^{16} = (1-p)^{16} = (1-0.2)^{16} = 0.8^{16} \approx 0.028\ .$$

Answer: 0.028.