Practice Questions:
Binomial Distribution and Poisson Distribution

Q-1. College-Pro Painting does home interior and exterior painting. The company uses inexperienced painters that do not always do a high-quality job. It believes that its painting process can be described by a Poisson distribution with an average of 4.8 defects per 400 square feet of painting.

a. What is the probability that a 400-square-foot painted section will have fewer than 6 blemishes?

b. What is the probability that six randomly sampled sections of size 400 square feet will each have 7 or fewer blemishes?

c. What is the probability that a 1200-square-foot painted section will have fewer than 5 blemishes?

Q-2. Dell Computers receives large shipments of microprocessors from Intel Corp. It must try to ensure the proportion of microprocessors that are defective is small. Suppose Dell decides to test five microprocessors out of a shipment of thousands of these microprocessors. Suppose that if at least one of the microprocessors is defective, the shipment is returned.

a. If Intel Corp.'s shipment contains 10% defective microprocessors, calculate the probability the entire shipment will be returned.

b. If Intel and Dell agree that Intel will not provide more than 5% defective chips, calculate the probability that the entire shipment will be returned even though only 5% are defective.

c. Calculate the probability that the entire shipment will be kept by Dell even though the shipment has 10% defective microprocessors.

Q-3. On average, 3 traffic accidents per month occur at a certain intersection. What is the probability that in any given month at this intersection:

a. exactly 5 accidents will occur?

b. fewer than 3 accidents will occur?

c. at least 2 accidents will occur?

Q-4. It is known that 60% of mice inoculated with a serum are protected from a certain disease. If 5 mice are inoculated, find the probability that

a. none contracts the disease;

b. fewer than 2 contract the disease;

c. more than 3 contract the disease.

Q-5. An inventory study determines that, on average, demands for a particular item at a warehouse are made 5 times per day. What is the probability that on a given day this item is requested more than 3 times?

Q-6. The probability that a student at a local high school fails the screening test for scoliosis (curvature of the spine) is known to be 0.004. Of the next 1875 students at the school who are screened for scoliosis, find the probability that

a. fewer than 5 fail the test;
b. 8, 9, or 10 fail the test.

Q-7. The probability that a person will die when he or she contracts a virus infection is 0.001. Of the next 4000 people infected, what is the mean number who will die?

Q-8. A survey by KRC Research for *U.S. News* reported that 37% of people plan to spend more on eating out after they retire. If eight people are randomly selected, then determine the

a. expected number of people who plan to spend more on eating out after they retire
b. standard deviation of the individuals who plan to spend more on eating out after they retire
c. probability that two or fewer in the sample indicate that they plan to spend more on eating out after retirement

Q-9. A traffic control engineer reports that 75% of the vehicles passing through a checkpoint are from within the state. What is the probability that fewer than 4 of the next 9 vehicles are from out of state?

Q-10. A company purchases large lots of a certain kind of electronic device. A method is used that rejects a lot if 2 or more defective units are found in a random sample of 100 units.

a. What is the mean number of defective units found in a sample of 100 units if the lot is 1% defective?
b. What is the variance?

Q-11. Suppose that airplane engines operate independently and fail with probability equal to 0.4. Assuming that a plane makes a safe flight if at least one-half of its engines run, determine whether a 4-engine plane or a 2- engine plane has the higher probability for a successful flight.

Probability of 2 or more of 4 engines operating when $p = 0.6$ is

$$P(X \geq 2) = 1 - P(X \leq 1) = 0.8208,$$

and the probability of 1 or more of 2 engines operating when $p = 0.6$ is

$$P(X \geq 1) = 1 - P(X = 0) = 0.8400.$$

The 2-engine plane has a slightly higher probability for a successful flight when $p = 0.6$.

Q-12. On the average, 1 computer in 800 crashes during a severe thunderstorm. A certain company had 4,000 working computers when the area was hit by a severe thunderstorm. Compute the expected value and variance of the number of crashed computers. Also find the probability that at least 4 computers are crashed.

Q-13. John Thurgood founded a company that translates Chinese books into English. His company is currently testing a computer-based translation service. Since Chinese symbols are difficult to translate, John assumes the computer program will make some errors, but then so do human translators. The computer error rate is supposed to be an average of 3 per 400 words of translation. Suppose John randomly selects a 1,200-word passage. Assuming that the Poisson distribution applies, if the computer error rate is actually 3 errors per 400 words,

a. determine the probability that no errors will be found.

b. calculate the probability that more than 14 errors will be found.

c. find the probability that fewer than 9 errors will be found.

d. If 15 errors are found in the 1,200-word passage, what would you conclude about the computer company's claim? Why?

Q-14. Hospital administrators in large cities anguish about traffic in emergency rooms. At a particular hospital in a large city, the staff on hand cannot accommodate the patient traffic if there are more than 10 emergency cases in a given hour. It is assumed that patient arrival follows a Poisson process, and historical data suggest that, on the average, 5 emergencies arrive per hour.

a. What is the probability that in a given hour the staff cannot accommodate the patient traffic?

b. What is the probability that more than 20 emergencies arrive during a 3-hour shift?

Q-15. One prominent physician claims that 70% of those with lung cancer are chain smokers. If his assertion is correct,

a. find the probability that of 10 such patients recently admitted to a hospital, fewer than half are chain smokers;

b. find the probability that of 20 such patients recently admitted to a hospital, fewer than half are chain smokers.

Q-16. It is conjectured that an impurity exists in (p =) 30% of all drinking wells in a certain rural community. In order to gain some insight into the true extent of the problem, it is determined that some testing is necessary. It is too expensive to test all of the wells in the area, so 10 are randomly selected for testing. What is the probability that exactly 7 wells are impure? Use appropriate distribution.

Q-17. In a certain industrial facility, accidents occur infrequently. It is known that the probability of an accident on any given day is 0.005 and accidents are independent of each other. What is the probability that in any given period of 400 days there are at most three days with an accident?

Q-18. A nationwide survey of college seniors by the University of Michigan revealed that almost 70% disapprove of daily pot smoking, according to a report in Parade. If 12 seniors are selected at random and asked their opinion, find the probability that the number who disapprove of smoking pot daily is anywhere from 7 to 9.