and they can be considered to be independent for mutation. Determine the following probabilities. The binomial table in Appendix A can help.

(a) No samples are mutated.
(b) At most one sample is mutated.
(c) More than half the samples are mutated.

3-89. An article in Information Security Technical Report ("Malicious Software—Past, Present and Future" (2004, Vol. 9, pp. 6–18)) provided the following data on the top ten malicious software instances for 2002. The clear leader in the number of registered incidences for the year 2002 was the Internet worm "Klez," and it is still one of the most widespread threats. This virus was first detected on 20 October 2001, and it has held the top spot among malicious software for the longest period in the history of virology.

<table>
<thead>
<tr>
<th>Place</th>
<th>Name</th>
<th>% Instances</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>1-Worm.Klez</td>
<td>61.22%</td>
</tr>
<tr>
<td>2</td>
<td>2-Worm.Lentin</td>
<td>20.52%</td>
</tr>
<tr>
<td>3</td>
<td>3-Worm.Tanatos</td>
<td>2.09%</td>
</tr>
<tr>
<td>4</td>
<td>4-Worm.Budimbi</td>
<td>1.31%</td>
</tr>
<tr>
<td>5</td>
<td>Macro.Word97.Thus</td>
<td>1.19%</td>
</tr>
<tr>
<td>6</td>
<td>6-Worm.Hybris</td>
<td>0.60%</td>
</tr>
<tr>
<td>7</td>
<td>7-Worm.Bredix</td>
<td>0.32%</td>
</tr>
<tr>
<td>8</td>
<td>8-Worm.Magist</td>
<td>0.30%</td>
</tr>
<tr>
<td>9</td>
<td>Wee05.CIH</td>
<td>0.27%</td>
</tr>
<tr>
<td>10</td>
<td>10-Worm.Siream</td>
<td>0.24%</td>
</tr>
</tbody>
</table>

The 10 most widespread malicious programs for 2002 (Source—Kaspersky Labs).

Suppose that 20 malicious software instances are reported. Assume that the malicious sources can be assumed to be independent.
(a) What is the probability that at least one instance is "Klez"?
(b) What is the probability that three or more instances are "Klez"?
(c) What are the mean and standard deviation of the number of "Klez" instances among the 20 reported?

3-90. Heart failure is due to either natural occurrences (87%) or outside factors (13%). Outside factors are related to induced substances or foreign objects. Natural occurrences are caused by arterial blockage, disease, and infection. Suppose that 20 patients will visit an emergency room with heart failure. Assume that causes of heart failure between individuals are independent.
(a) What is the probability that three individuals have conditions caused by outside factors?
(b) What is the probability that three or more individuals have conditions caused by outside factors?
(c) What are the mean and standard deviation of the number of individuals with conditions caused by outside factors?

3-91. A computer system uses passwords that are exactly six characters and each character is one of the 26 letters (a–z) or 10 integers (0–9). Suppose there are 10,000 users of the system with unique passwords. A hacker randomly selects (with replacement) one billion passwords from the potential set, and a match to a user's password is called a hit.
(a) What is the distribution of the number of hits?
(b) What is the probability of no hits?
(c) What are the mean and variance of the number of hits?

3-92. A statistical process control chart example. Samples of 20 parts from a metal punching process are selected every hour. Typically, 1% of the parts require rework. Let X denote the number of parts in the sample of 20 that require rework. A process problem is suspected if X exceeds its mean by more than three standard deviations.
(a) If the percentage of parts that require rework remains at 1%, what is the probability that X exceeds its mean by more than three standard deviations?
(b) If the rework percentage increases to 4%, what is the probability that X exceeds 1?
(c) If the rework percentage increases to 4%, what is the probability that X exceeds 1 in at least one of the next five hours of samples?

3-93. Because not all airline passengers show up for their reserved seat, an airline sells 125 tickets for a flight that holds only 120 passengers. The probability that a passenger does not show up is 0.10, and the passengers behave independently.
(a) What is the probability that every passenger who shows up can take the flight?
(b) What is the probability that the flight departs with empty seats?

3-94. This exercise illustrates that poor quality can affect schedules and costs. A manufacturing process has 100 customer orders to fill. Each order requires one component part that is purchased from a supplier. However, typically, 2% of the components are identified as defective, and the components can be assumed to be independent.
(a) If the manufacturer stocks 100 components, what is the probability that the 100 orders can be filled without reordering components?
(b) If the manufacturer stocks 102 components, what is the probability that the 100 orders can be filled without reordering components?
(c) If the manufacturer stocks 105 components, what is the probability that the 100 orders can be filled without reordering components?

3-95. Consider the lengths of stay at a hospital's emergency department in Exercise 3-29. Assume that five persons independently arrive for service.
(a) What is the probability that the length of stay of exactly one person is less than or equal to 4 hours?
(b) What is the probability that exactly two people wait more than 4 hours?