1. Let $X =$ time between calls to a service center. It is known that $X$ follows an exponential distribution with a mean of 15 minutes.
   - a. What is the probability that $X$ is greater than 20 minutes? (4 pts)
   - b. If there is no service call during the last 10 minutes, what is the probability that there will be no service call during the next 30 minutes? (4 pts)
   - c. Find the 90\textsuperscript{th} percentile of $X$ [Hint: $P(X \leq 90\textsuperscript{th} \text{ percentile of } X) = 0.9$]. (4 pts)
   - d. What is the median time between calls to the service center? (4 pts)

2. The New Jersey Department of Motor Vehicles reported that 70\% of all vehicles undergoing emissions test passed the test on the first try. Essex County claims that it has a higher rate of vehicles passing emissions test on the first try than the statewide average. In order to test this claim, a random sample of emission test results of 200 vehicles from Essex County was examined and it was found that 150 vehicles passed the emission test on the first try.
   - a. Formulate your hypotheses and explain the rationale for choosing those hypotheses. (5 pts)
   - b. Do the sample data to support the Essex County claim, when the significance level is $\alpha = .05$? (5 pts)
   - c. Find the P-value of the hypotheses test in Part (b). (4 pts)

3. A diagnostic test has been developed to detect a rare disease. When an adult has the disease, a positive result occurs 99\% of the time. On the other hand, when an adult does not have the disease, a false positive result occurs 2\% of the time. Based on past records, 0.2\% of the adults in the population have this rare disease. An adult is chosen at random for testing.
   - a. What is the probability that the test result for this adult is positive? (5 pts)
   - b. If the test result is positive, what is the probability that this adult has the disease? (5 pts)
   - c. If the test result is negative, what is the probability that this adult does not have the disease? (5 pts)
4. The number of defective components produced by a factory in a typical day’s production run has a Poisson distribution with a mean of 20. Each defective component has a probability 0.60 of being repairable.

   a. Find the probability that exactly 19 defectives are produced on a day. (4 pts)
   b. If 19 defective components are produced in a day, find the probability that exactly 10 of them are repairable. (4 pts)
   c. Find the probability that on a day exactly 19 defective components are produced and exactly 10 of them are repairable. (4 pts)

5. Two microprocessors are compared based on their performance in processing computer codes. A random sample of 6 computer codes was used on each processor to determine whether there is a difference in speed. The speeds in seconds are shown below:

<table>
<thead>
<tr>
<th>Code</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
</tr>
</thead>
<tbody>
<tr>
<td>Microprocessor A</td>
<td>27.2</td>
<td>18.1</td>
<td>27.2</td>
<td>19.7</td>
<td>24.5</td>
<td>22.1</td>
</tr>
<tr>
<td>Microprocessor B</td>
<td>24.1</td>
<td>19.3</td>
<td>26.8</td>
<td>20.1</td>
<td>27.6</td>
<td>29.8</td>
</tr>
</tbody>
</table>

   a. Formulate your hypotheses. (4 pts)
   b. Can you conclude that the mean speeds of the two processors are different at \( \alpha = 0.05 \)? (4 pts)
   c. Find the P-value of your test in Part (b). (4 pts)

6. The drying time of paint follows a normal distribution with a mean of 75 minutes. A chemist claims that his new mix of the paint decreases the drying time. A random sample of 25 test specimens of the new mix of the paint was applied and the sample average drying time was 72.3 minutes and the sample standard deviation was 5 minutes.

   a. Formulate your hypotheses and explain why you chose those hypotheses. (5 pts)
   b. Do the sample data support the chemist’s claim at the significance level of \( \alpha = .01 \)? (5 pts)
   c. Find the P-value for the test in part (b)? (5 pts)

7. The mean compressive strength of a particular type of brick is specified to be 3200 psi. A building inspector claims that the true mean strength of this brick is less than 3200 psi. A random sample of 49 bricks was selected for testing, which resulted in the following summary: sample mean = 3115 psi and sample standard deviation = 180 psi.

   a. Do the sample data support the inspector’s claim at the significance level of \( \alpha = 0.01 \)? (4 pts)
   b. Show your hypotheses tested in Part (a) and explain why you chose them. (4 pts)
   c. What is the P-value for your hypotheses test? (4 pts)
   d. If it is discovered that the sample mean and standard deviation are based on 9 observations instead of 49 observations, what will change in the way you conducted the hypotheses test in Part (a)? (4 pts)