MULTIPLE CHOICE (2pts each)

1. If the individual outcomes of a phenomenon are uncertain, but there is nonetheless a regular distribution of outcomes in a large number of repetitions, we say the phenomenon is
   A) random.
   B) predictable.
   C) deterministic.
   D) none of the above.

2. Suppose we have a loaded die that gives the outcomes 1–6 according to the following probability distribution:

   \[
   \begin{array}{c|ccccccc}
   X & 1 & 2 & 3 & 4 & 5 & 6 \\
   \hline
   P(X) & 0.1 & 0.2 & 0.3 & 0.2 & 0.1 & 0.1 \\
   \end{array}
   \]

   Note that for this die all outcomes are not equally likely, as they would be if the die were fair. If this die is rolled 6000 times, the number of times we get a 2 or a 3 should be about
   A) 1000.
   B) 2000.
   C) 3000.
   D) 4000.

3. Suppose we roll a red die and a green die. Let A be the event that the number of spots showing on the red die is 3 or less and B be the event that the number of spots showing on the green die is more than 3. The events A and B are
   A) disjoint.
   B) complements.
   C) independent.
   D) reciprocals.

4. I select two cards from a deck of 52 cards and observe the color of each (26 cards in the deck are red and 26 are black). Which of the following is an appropriate sample space S for the possible outcomes?
   A) S = \{red, black\}
   B) S = \{(red, red), (red, black), (black, red), (black, black)\}, where, for example, (red, red) stands for the event “the first card is red and the second card is red.”
   C) S = \{0, 1, 2\}
   D) All of the above.
If you draw an M&M candy at random from a bag of the candies, the candy you draw will have one of six colors. The probability of drawing each color depends on the proportion of each color among all candies made. Assume the table below gives the probability that a randomly chosen M&M has each color.

<table>
<thead>
<tr>
<th>Color</th>
<th>Brown</th>
<th>Red</th>
<th>Yellow</th>
<th>Green</th>
<th>Orange</th>
<th>Tan</th>
</tr>
</thead>
<tbody>
<tr>
<td>Probability</td>
<td>.3</td>
<td>.3</td>
<td>?</td>
<td>.1</td>
<td>.1</td>
<td>.1</td>
</tr>
</tbody>
</table>

5. The probability of drawing a yellow candy is
   A) .1.
   B) .2.
   C) .3.
   D) impossible to determine from the information given.

Ignoring twins and other multiple births, assume babies born at a hospital are independent events with the probability that a baby is a boy and the probability that a baby is a girl both equal to 0.5.

6. Referring to the information above, the probability that the next three babies are of the same sex is
   A) 1.0.
   B) 0.125.
   C) 0.250.
   D) 0.500.

7. Suppose that A and B are two independent events with \( P(A) = 0.3 \) and \( P(B) = 0.3 \). \( P(A \cup B) \) is
   A) 0.09.
   B) 0.51.
   C) 0.52.
   D) 0.60.
A system has two components that operate in parallel, as shown in the diagram below. Since the components operate in parallel, at least one of the components must function properly if the system is to function properly. The probabilities of failures for the components 1 and 2 during one period of operation are .20 and .03, respectively. Let F denote the event that component 1 fails during one period of operation and G denote the event that component 2 fails during one period of operation. The component failures are independent.

8. The event corresponding to the system failing during one period of operation is
   A) \( F \cap G \).
   B) \( F \cup G \).
   C) \( F^c \cup G^c \).
   D) \( F^c \cap G^c \).

9. The probability that the system functions properly during one period of operation is closest to
   A) 0.994.
   B) 0.970.
   C) 0.940.
   D) 0.776.

An event A will occur with probability 0.5. An event B will occur with probability 0.6. The probability that both A and B will occur is 0.1.

10. Referring to the information above, the conditional probability of A given B
    A) is 0.3.
    B) is 0.2.
    C) is 1/6.
    D) cannot be determined from the information given.
11. Event A occurs with probability 0.4. The conditional probability that A occurs given
that B occurs is 0.5, while the conditional probability that A occurs given that B does
not occur is 0.2. What is the conditional probability that B occurs given that A occurs?
A) 0.
B) 4/9.
C) 5/6.
D) This cannot be determined from the information given.

12. Event A occurs with probability 0.3 and event B occurs with probability 0.4. If A and B
are independent, we may conclude
A) $P(A \text{ and } B) = 0.12.$
B) $P(A|B) = 0.3.$
C) $P(B|A) = 0.4.$
D) all of the above.
FREE RESPONSE

1) P(A) = .5  P(B) = .7  P(\(A \cap B\)) = .35  
   a. Draw and Label a Venn Diagram to represent the probabilities.  
      
   b. P(\(A \cup B\)) =  
   c. P(\(A' \cup B\)) =  
   d. P(\(A' \cup B'\)) =  
   e. P((\(A \cap B\))') =  

2) P(A) = .4  P(B) = .25  P(\(A \cup B\)) = .55  
   a. Find P(\(A \cap B\))  
   b. Find P(A|B)  
   c. Are A and B independent?  

3) Heart disease is the number one killer today. Suppose that 8% of the patients in a small town are known to have heart disease. And suppose that a test is available that is positive in 96% of the patients with heart disease, but is also positive in 7% of patients who do not have heart disease. If a person is selected at random and given the test and it comes out positive, what is the probability that the person actually has heart disease?  

(10pts)
(6pts)
(4pts)
4) A simple random sample of adults living in a suburb of a large city was selected. The age and annual income of each adult in the sample were recorded. The resulting data are summarized in the table below.

<table>
<thead>
<tr>
<th>Age Range</th>
<th>$25000 - $35000</th>
<th>$35001 - $50000</th>
<th>Over $50000</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>21-30</td>
<td>8</td>
<td>15</td>
<td>27</td>
<td>50</td>
</tr>
<tr>
<td>31-45</td>
<td>22</td>
<td>32</td>
<td>35</td>
<td>89</td>
</tr>
<tr>
<td>46-60</td>
<td>12</td>
<td>14</td>
<td>27</td>
<td>53</td>
</tr>
<tr>
<td>Over 60</td>
<td>5</td>
<td>3</td>
<td>7</td>
<td>15</td>
</tr>
<tr>
<td>Total</td>
<td>47</td>
<td>64</td>
<td>96</td>
<td>207</td>
</tr>
</tbody>
</table>

a) What is the probability that a person chosen at random makes between $35,001 and $50,000?

b) What is the probability that a person chosen at random from the group of adults between 46 and 60 will be in the $35,001 - $50,000 group?

c) **Based on your answers to parts (a) and (b), is annual income independent of age category for those in this sample? Explain.**

(10pts)
5) Suppose you are given a standard six-sided die and told that the die is “loaded” in such a way that while the numbers 1, 3, 4, and 6 are equally likely to turn up, the numbers 2 and 5 are three times as likely to turn up as any of the other numbers.
   a. The die is rolled once and the number turning up is observed. Use the information given above to fill in the following table: (2pts)
   
<table>
<thead>
<tr>
<th>Outcome</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
</tr>
</thead>
<tbody>
<tr>
<td>Probability</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

   b. Let A be the event: the number rolled is a prime number (a number is prime if its only factors are 1 and the number itself; note that 1 is not prime). List the outcomes in A and find P(A) (2pts)

   c. Let B be the event: the number rolled is an even number. List the outcomes in B and find P(B). (2pts)

   d. Are events A and B disjoint? Explain briefly. (3pts)

   e. Determine if events A and B are independent. (3pts)

6) The chance that Mr. Wonderful will get a date with a random lady at the local bar is 0.6. Suppose each lady’s answer is independent of what other ladies have said. On any given night, Mr. Wonderful asks out 6 random ladies.
   a. Find the probability that all 6 women turn Mr. Wonderful down. (3pts)

   b. Find the probability of Mr. Wonderful getting at least one date. (3pts)
7) May has applied to both Harvard and the University of Florida. She thinks the probability that Harvard will admit her is 0.4, the probability that Florida will admit her is 0.5, and the probability that both will admit her is 0.2.
   a. What is the probability that neither university admits May? (3pts)
   b. What is the probability that she gets into Florida but not Harvard? (3pts)

8) Sweet Sassy Molassey U is playing Backwater A&M for the conference football championship. If Backwater's 1st string QB is healthy, they have a 72% chance of winning. If they have to start the backup, their chances of winning drop to 30%. The team physician says there is a 60% chance that the first string QB will play.
   a. Draw a tree diagram to represent this situation. Label all probabilities (5pts)
   b. What is the probability that Sweet Sassy Molassey will win the game? (2pts)
   c. Supposed you missed the game but read the next day that SSMU won. What is the probability that Backwater started their 1st string QB? (3pts)
9) Many fire stations handle emergency calls for medical assistance as well as those requesting firefighting equipment. A particular station says that the probability that an incoming call is for medical assistance is 0.85. This can be expressed as $P(\text{call is for medical assistance}) = 0.85$.

a) Give a relative frequency interpretation of the given problem. (2pts)

b) What is the probability that a call is not for medical assistance? (2pts)

c) Assuming that successive calls are independent of one another, calculate the probability that two successive calls will both be for medical assistance. (2pts)

d) Still assuming independence, calculate the probability that for two successive calls, the first is for medical assistance and the second is not for medical assistance. (2pts)

e) Still assuming independence, calculate the probability that exactly one of the next two calls will be for medical assistance. (2pts)

f) Do you think that it is reasonable to assume that the requests made in successive calls are independent? Explain briefly. (2pts)
Answer Key

1. A
2. C
3. C
4. B
5. A
6. C
7. B
8. A
9. A
10. C
11. C
12. D