Chapter 5
A Survey of Probability Concepts

True/False

1. Based on a classical approach, the probability of an event is defined as the number of favorable outcomes divided by the total number of possible outcomes.
   Answer: True

2. If only one of several events can occur at a time, we refer to these events as being mutually exclusive events.
   Answer: True

3. The classical approach to probability requires that the outcomes of an experiment are not equally likely.
   Answer: False

4. The probability of rolling a 3 or 2 on a single die is an example of conditional probability.
   Answer: False

5. The probability of rolling a 3 or 2 on a single die is an example of mutually exclusive events.
   Answer: True

6. Events that cannot occur simultaneously are said to be outcomes.
   Answer: False

7. The probability of rolling a 3 or 2 on a single die is an example of joint probability.
   Answer: True

8. The probability assigned to an event that is certain not to occur is 1.0.
   Answer: False

9. The probability assigned to an event that is certain not to occur is 0.0.
   Answer: True

10. If an experiment, such as a die-tossing experiment, has a set of events that includes every possible outcome, the set of events is called collectively exhaustive.
    Answer: True

11. An individual can assign a subjective probability to an event based on the individual's knowledge about the event.
    Answer: True

12. To apply the special rule of addition, the events must be mutually exclusive.
    Answer: True

13. To apply the special rule of addition, the events must be independent.
    Answer: False
14. The probability that you would assign to the likelihood that the Tampa Bay Buccaneers will be in the Super Bowl this season must be between 0 and 10.
Answer: False

15. A joint probability is a probability that measures the likelihood that two or more events will happen concurrently.
Answer: True

16. If there are two independent events $A$ and $B$, the probability that $A$ and $B$ will occur is found by multiplying the two probabilities. Thus for two events $A$ and $B$, the special rule of multiplication shown symbolically is:
\[ P(A \text{ and } B) = P(A) P(B). \]
Answer: True

17. The general rule of multiplication is used to find the joint probability that two events will occur. Symbolically, the general rule of multiplication is
\[ P(A \text{ and } B) = P(A) P(B|A). \]
Answer: True

18. A tree diagram is very useful for portraying conditional and joint probabilities.
Answer: True

19. A coin is tossed four times. The probability is $\frac{1}{4}$ or 0.25 that all four tosses will result in a head face up.
Answer: False

20. If there are 'm' ways of doing one thing and 'n' ways of doing another thing, the multiplication formula states that there are $(m) \cdot (n)$ ways of doing both.
Answer: True

21. A permutation is an arrangement of a set of objects in which there is an order from the first through the last.
Answer: True

22. A combination is an arrangement of a set of objects in which there is an order from the first through the last.
Answer: False

23. Two coins are tossed. The tossing of the coins is called an experiment, and one possible event is two heads.
Answer: True

24. The complement rule states that the probability of an event not occurring is equal to one minus the probability of its occurrence.
Answer: True

25. If two events are mutually exclusive, then $P(A \text{ or } B) = P(A) P(B)$.
Answer: False

26. The combination formula is: $n! / (n - r)!$
Answer: False
27. A probability is a number from –1 to +1 inclusive that measures one's belief that an event resulting from an experiment will occur.
   Answer: False

28. An experiment is an activity that is either observed or measured.
   Answer: True

30. A probability is usually expressed as a decimal, such as 0.70 or 0.27, but it can also be expressed as a fraction, such as 7/10 or 27/100.
   Answer: True

31. A tree diagram portrays outcomes that are mutually exclusive.
   Answer: True

32. The closer a probability is to 0, the more likely that an event will happen. The closer the probability is to 1.00, the more likely an event will not happen.
   Answer: False

33. It was announced that the probability of rain tomorrow is –1.0. Such a low probability of –1.0 indicates that there is no chance of rain.
   Answer: False

34. Bayes' theorem is a method to revise the probability of an event given additional information.
   Answer: True

35. Bayes's theorem calculates a conditional probability called a posterior or revised probability.
   Answer: True

36. Bayes' theorem is used to calculate a subjective probability.
   Answer: False

Multiple Choice

37. The National Center for Health Statistics reported that of every 883 deaths in recent years, 24 resulted from an automobile accident, 182 from cancer and 333 from heart disease. Using the relative frequency approach, what is the probability that a particular death is due to an automobile accident?
   A) 24/883 or 0.027
   B) 539/883 or 0.610
   C) 24/333 or 0.072
   D) 182/883 or 0.206
   Answer: A

38. If two events A and B are mutually exclusive, what does the special rule of addition state?
   A) \( P(A \text{ or } B) = P(A) + P(B) \)
   B) \( P(A \text{ and } B) = P(A) + P(B) \)
   C) \( P(A \text{ and/or } B) = P(A) + P(B) \)
   D) \( P(A \text{ or } B) = P(A) + P(B) \)
   Answer: A

39. What does the complement rule state?
   A) \( P(A) = P(A) - P(B) \)
B) \[ P(A) = 1 - P(\text{not } A) \]
C) \[ P(A) = P(A) \cdot P(B) \]
D) \[ P(A) = P(A)X + P(B) \]
Answer: B

40. Which approach to probability is exemplified by the following formula?
Probability of an Event =

\[
\frac{\text{Number of times event occurred in the past}}{\text{Total number of observations}}
\]

A) Classical approach
B) Empirical approach
C) Subjective approach
D) None of the above
Answer: B

41. A study of 200 computer service firms revealed these incomes after taxes:

<table>
<thead>
<tr>
<th>Income After Taxes</th>
<th>Number of Firms</th>
</tr>
</thead>
<tbody>
<tr>
<td>Under $1 million</td>
<td>102</td>
</tr>
<tr>
<td>$1 million up to $20 million</td>
<td>61</td>
</tr>
<tr>
<td>$20 million and more</td>
<td>37</td>
</tr>
</tbody>
</table>

What is the probability that a particular firm selected has $1 million or more in income after taxes?
A) 0.00
B) 0.25
C) 0.49
D) 0.51
Answer: C

42. Routine physical examinations are conducted annually as part of a health service program for the employees. It was discovered that 8% of the employees needed corrective shoes, 15% needed major dental work and 3% needed both corrective shoes and major dental work. What is the probability that an employee selected at random will need either corrective shoes or major dental work?
A) 0.20
B) 0.25
C) 0.50
D) 1.00
E) None of the above
Answer: A

43. A survey of top executives revealed that 35% of them regularly read Time magazine, 20% read Newsweek and 40% read U.S. News & World Report. Ten percent read both Time and U.S. News & World Report. What is the probability that a particular top executive reads either Time or U.S. News & World Report regularly?
A) 0.85
B) 0.06
C) 1.00
D) 0.65
Answer: D
A study by the National Park Service revealed that 50% of the vacationers going to the Rocky Mountain region visit Yellowstone Park, 40% visit the Grand Tetons and 35% visit both. What is the probability that a vacationer will visit at least one of these magnificent attractions?

A) 0.95  
B) 0.35  
C) 0.55  
D) 0.05  
Answer: C

A tire manufacturer advertises, "the median life of our new all-season radial tire is 50,000 miles. An immediate adjustment will be made on any tire that does not last 50,000 miles." You purchased four of these tires. What is the probability that all four tires will wear out before traveling 50,000 miles?

A) 1/10, or 0.10  
B) ¼, or 0.25  
C) 1/64, or 0.0156  
D) 1/16, or 0.0625  
Answer: D

A sales representative calls on four hospitals in Westchester County. It is immaterial what order he calls on them. How many ways can he organize his calls?

A) 4  
B) 24  
C) 120  
D) 37  
Answer: B

There are 10 rolls of film in a box and 3 are defective. Two rolls are to be selected without replacement. What is the probability of selecting a defective roll followed by another defective roll?

A) 1/2, or 0.50  
B) 1/4, or 0.25  
C) 1/120, or about 0.0083  
D) 1/15, or about 0.07  
Answer: D

A board of directors consists of eight men and four women. A four-member search committee is to be chosen at random to recommend a new company president. What is the probability that all four members of the search committee will be women?

A) 1/120 or 0.0083  
B) 1/16 or 0.0625  
C) 1/8 or 0.125  
D) 1/495 or 0.002  
Answer: D

A lamp manufacturer has developed five lamp bases and four lampshades that could be used together. How many different arrangements of base and shade can be offered?

A) 5  
B) 10  
C) 15  
D) 20  
Answer: D
51. A gum ball machine has just been filled with 50 black, 150 white, 100 red and 100 yellow gum balls that have been thoroughly mixed. Sue and Jim approached the machine first. They both said they wanted red gum balls. What is the likelihood they will get their wish?
A) 0.50
B) 0.062
C) 0.33
D) 0.75
Answer: B

52. What does \( \frac{6!}{2! \cdot 4!} \) equal?
A) 640
B) 36
C) 10
D) 120
E) None of the above
Answer: C

53. In a management trainee program, 80 percent of the trainees are female, 20 percent male. Ninety percent of the females attended college, 78 percent of the males attended college. A management trainee is selected at random. What is the probability that the person selected is a female who did NOT attend college?
A) 0.20
B) 0.08
C) 0.25
D) 0.80
Answer: B

54. Three defective electric toothbrushes were accidentally shipped to a drugstore by the manufacturer along with 17 non-defective ones. What is the probability that the first two electric toothbrushes sold will be returned to the drugstore because they are defective?
A) 3/20 or 0.15
B) 3/17 or 0.176
C) 1/4 or 0.25
D) 3/190 or 0.01579
Answer: D

55. An electronics firm sells four models of stereo receivers, three CD decks, and six speaker brands. When the four types of components are sold together, they form a "system." How many different systems can the electronics firm offer?
A) 36
B) 18
C) 72
D) 144
Answer: C

57. There are two letters C and D. If repetitions such as CC are permitted, how many permutations are possible?
A) 1
B) 0
C) 4
D) 8
Answer: C

61. The ABCD football association is considering a Super Ten Football Conference. The top 10 football teams in the country, based on past records, would be members of the Super Ten Conference. Each team would play every other team in the conference during the season and the team winning the most games would be declared the national champion. How many games would the conference commissioner have to schedule each year? (Remember, Oklahoma versus Michigan is the same as Michigan versus Oklahoma.)
A) 45
B) 50
C) 125
D) 14
Answer: A

63. The first card selected from a standard 52-card deck was a king. If it is returned to the deck, what is the probability that a king will be drawn on the second selection?
A) 1/4 or 0.25
B) 1/13, or 0.077
C) 12/13, or 0.923
D) 1/3 or 0.33
Answer: B

64. The first card selected from a standard 52-card deck was a king. If it is NOT returned to the deck, what is the probability that a king will be drawn on the second selection?
A) 1/3 or 0.33
B) 1/51, or 0.0196
C) 3/51, or 0.0588
D) 1/13 or 0.077
Answer: C

66. An experiment may have:
A) Only one result
B) Only two results
C) Two or more results
D) None of the above
Answer: C

67. When are two events mutually exclusive?
A) They overlap on a Venn diagram
B) If one event occurs, then the other cannot
C) Probability of one affects the probability of the other
D) Both (a) and (b)
Answer: B

69. The result of a particular experiment is called a(n)
A) observation.
B) conditional probability.
C) event.
D) outcome.
Answer: D
70. The probability of two or more events occurring concurrently is called a
A) conditional probability.
B) empirical probability.
C) joint probability.
D) tree diagram.
E) none of the above.
Answer: C

71. The probability of an event that is affected by two or more different events is called a
A) conditional probability.
B) empirical probability.
C) joint probability.
D) tree diagram.
E) none of the above.
Answer: A

72. A graphical method useful in calculating joint and conditional probability is
A) a tree diagram.
B) a Venn diagram.
C) a histogram.
D) inferential statistics.
Answer: A

73. When an experiment is conducted "without replacement",
A) events are independent
B) events are equally likely
C) the experiment can be illustrated with a Venn Diagram
D) the probability of two or more events is computed as a joint probability
Answer: D

74. If two events are independent, then their joint probability is
A) computed with the special rule of addition
B) computed with the special rule of multiplication
C) computed with the general rule of multiplication
D) computed with Bayes theorem
Answer: B

75. When applying the special rule of addition for mutually exclusive events, the joint probability is:
A) 1
B) .5
C) 0
D) unknown
Answer: C

76. A student received an "A" on the first test of the semester. The student wants to calculate the probability of scoring an "A" on the second test. Historically, the instructor knows that the joint probability of scoring "A"s on the first two tests is 0.5. Also, historically, the probability that a student scores an "A" on the second test given that a student scored an "A" on the first test is 0.9. What is the probability that a student will score an "A" on the second test?
A) 0.50
B) 0.95
C) 0.55  
D) 0.90  
Answer: C

77. When an event's probability depends on the likelihood of another event, the probability is a  
A) conditional probability.  
B) empirical probability.  
C) joint probability.  
D) Mutually exclusive probability.  
Answer: A

78. Using the terminology of Bayes' Theorem, a posterior probability can also be defined as:  
A) a conditional probability  
B) a joint probability  
C) 1  
D) 0  
Answer: A

79. The process used to calculate the probability of an event given additional information has been obtained is  
A) Bayes's theorem.  
B) classical probability.  
C) permutation.  
D) subjective probability.  
Answer: A

**Fill-in-the-Blank**

80. Complete the following analogy: an experiment relates to the roll of a die, as an outcome relates to  
________.  
Answer: Any one value between 1 and 6

81. If a set of events are collectively exhaustive and mutually exclusive, what does the sum of the probabilities equal?  
Answer: 1

82. When the special rule of multiplication is used events A and B must be  
________.  
Answer: independent

83. Suppose four heads appeared face up on four tosses of a coin. What is the probability that a head will appear face up in the next toss of the coin?  
Answer: 1/2 or 0.5

84. What approach to probability is based on a person's degree of belief and hunches that a particular event will happen?  
Answer: subjective

85. If there are five vacant parking places and five automobiles arrive at the same time, in how many different ways they can park?  
Answer: 120
86. A collection of one or more possible outcomes of an experiment is called an ______________.
Answer: event

87. A new computer game has been developed and 80 veteran game players will test its market potential. If sixty players liked the game, what is the probability that any veteran game player will like the new computer game? ______
Answer: 3/4 or 0.75

88. A company has warehouses in four regions: South, Midwest, Rocky Mountain and Far West. The company will randomly select one warehouse to store a seldom-used item. What is the probability that the warehouse selected will be in the Far West region? ______
Answer: 1/4 or 0.25

89. One card will be randomly selected from a standard 52-card deck of cards. What is the probability that it will be the jack of hearts? ______
Answer: 1/52 or 0.0192

91. If there is absolutely no chance a person will purchase a new car this year, what is the probability assigned to this event? ______
Answer: zero

92. What is the probability that a one-spot or a two-spot or a six-spot will appear face up on the throw of one die? ______
Answer: 1/2 or 0.5

94. What is a probability that is based on someone's opinion or guess called? ________________
Answer: subjective

95. What is a particular result of an experiment called? ______
Answer: outcome

96. What is a collection of one or more basic outcomes called? ______
Answer: event

98. What are two events called when the occurrence of one event does not affect the occurrence of the other event? ________________
Answer: independent

99. What is it called when the order of a set of objects selected from a single group is important? ______
Answer: permutation

100. The method for calculating the probability of an event given there is additional information is called ________________.
Answer: Bayes' theorem

101. The probability that a specific event will occur given that a specific other event has occurred is what type of probability? ________________
Answer: conditional probability
Multiple Choice

Use the following to answer questions 102-106:
A group of employees of Unique Services will be surveyed about a new pension plan. In-depth interviews with each employee selected in the sample will be conducted. The employees are classified as follows:

<table>
<thead>
<tr>
<th>Classification</th>
<th>Event</th>
<th>Number of Employees</th>
</tr>
</thead>
<tbody>
<tr>
<td>Supervisors</td>
<td>A</td>
<td>120</td>
</tr>
<tr>
<td>Maintenance</td>
<td>B</td>
<td>50</td>
</tr>
<tr>
<td>Production</td>
<td>C</td>
<td>1,460</td>
</tr>
<tr>
<td>Management</td>
<td>D</td>
<td>302</td>
</tr>
<tr>
<td>Secretarial</td>
<td>E</td>
<td>68</td>
</tr>
</tbody>
</table>

102. What is the probability that the first person selected is classified as a maintenance employee?
A) 0.20
B) 0.50
C) 0.025
D) 1.00
E) None of the above
Answer: C

103. What is the probability that the first person selected is either in maintenance or in secretarial?
A) 0.200
B) 0.015
C) 0.059
D) 0.001
Answer: C

104. What is the probability that the first person selected is either in management or in supervision?
A) 0.00
B) 0.06
C) 0.15
D) 0.21
Answer: A

105. What is the probability that the first person selected is a supervisor and in management?
A) 0.00
B) 0.06
C) 0.15
D) 0.21
Answer: A

Use the following to answer questions 106-108:
Each salesperson in a large department store chain is rated on their sales ability and their potential for advancement. The data for the 500 sampled salespeople are summarized in the following table.

<table>
<thead>
<tr>
<th>Sales Ability</th>
<th>Potential for Advancement</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Fair</td>
</tr>
<tr>
<td>Below Average</td>
<td>16</td>
</tr>
<tr>
<td>Average</td>
<td>45</td>
</tr>
<tr>
<td>Above Average</td>
<td>93</td>
</tr>
</tbody>
</table>
106. What is the probability that a salesperson selected at random has above average sales ability and is an excellent potential for advancement?
   A) 0.20
   B) 0.50
   C) 0.27
   D) 0.75
   Answer: C

107. What is the probability that a salesperson selected at random will have average sales ability and good potential for advancement?
   A) 0.09
   B) 0.12
   C) 0.30
   D) 0.525
   Answer: B

108. What is the probability that a salesperson selected at random will have below average sales ability and fair potential for advancement?
   A) 0.032
   B) 0.10
   C) 0.16
   D) 0.32
   Answer: A

109. What is the probability that a salesperson selected at random will have an excellent potential for advancement given they also have above average sales ability?
   A) 0.27
   B) 0.60
   C) 0.404
   D) 0.45
   Answer: D

110. What is the probability that a salesperson selected at random will have an excellent potential for advancement given they also have average sales ability?
   A) 0.27
   B) 0.30
   C) 0.404
   D) 0.45
   Answer: B

Use the following to answer questions 111-113:
A study of the opinion of designers with respect to the primary color most desirable for use in executive offices showed that:

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Test Bank, Chapter 5
<table>
<thead>
<tr>
<th>Primary Color</th>
<th>Number of Opinions</th>
</tr>
</thead>
<tbody>
<tr>
<td>Red</td>
<td>92</td>
</tr>
<tr>
<td>Orange</td>
<td>86</td>
</tr>
<tr>
<td>Yellow</td>
<td>46</td>
</tr>
<tr>
<td>Green</td>
<td>91</td>
</tr>
<tr>
<td>Blue</td>
<td>37</td>
</tr>
<tr>
<td>Indigo</td>
<td>46</td>
</tr>
<tr>
<td>Violet</td>
<td>2</td>
</tr>
</tbody>
</table>

111. What is the probability that a designer does not prefer red?
A) 1.00  
B) 0.77  
C) 0.73  
D) 0.23  
Answer: B

112. What is the probability that a designer does not prefer yellow?
A) 0.000  
B) 0.765  
C) 0.885  
D) 1.000  
Answer: C

113. What is the probability that a designer does not prefer blue?
A) 1.0000  
B) 0.9075  
C) 0.8850  
D) 0.7725  
Answer: B

Use the following to answer questions 114-115:
An automatic machine inserts mixed vegetables into a plastic bag. Past experience revealed that some packages were underweight and some were overweight, but most of them had satisfactory weight.

<table>
<thead>
<tr>
<th>Weight</th>
<th>% of Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Underweight</td>
<td>2.5</td>
</tr>
<tr>
<td>Satisfactory</td>
<td>90.0</td>
</tr>
<tr>
<td>Overweight</td>
<td>7.5</td>
</tr>
</tbody>
</table>

114. What is the probability of selecting three packages that are overweight?
A) 0.0000156  
B) 0.0004218  
C) 0.0000001  
D) 0.075  
Answer: B

115. What is the probability of selecting three packages that are satisfactory?
A) 0.900  
B) 0.810  
C) 0.729  
D) 0.075  
Answer: C
Use the following to answer questions 116-118:
A mortgage holding company has found that 2% of its mortgage holders default on their mortgage and lose the property. Furthermore, 90% of those who default are late on at least two monthly payments over the life of their mortgage as compared to 45% of those who do not default.

116. What is the joint probability that a mortgagee has two or more late monthly payments and does not default on the mortgage?
A) 0.432  
B) 0.441  
C) 0.018  
D) 0.039  
Answer: B

117. What is the joint probability that a mortgagee has one or less late monthly payments and does not default on the mortgage?
A) 0.528  
B) 0.539  
C) 0.002  
D) 0.039  
Answer: A

118. Based on Bayes' Theorem, what is the posterior probability that a mortgagee will not default given one or less payments over the life of the mortgage?
A) Nearly 1  
B) Nearly 0  
C) 0.538  
D) 0.98  
E) Cannot be computed  
Answer: A

Fill-in-the-Blank
Use the following to answer questions 119-121:
A cell phone salesperson has kept records on the customers who visited the store. 40% of the customers who visited the store were female. Furthermore, the data show that 35% of the females who visited his store purchased a cell phone, while 20% of the males who visited his store purchased a cell phone. Let $A_1$ represent the event that a customer is a female, $A_2$ represent the event that a customer is a male, and $B$ represent the event that a customer will purchase a phone.

119. What is the probability that a female customer will purchase a cell phone?
Answer: $P(B|A_1) = .35$

120. What is the probability that a male customer will purchase a cell phone?
Answer: $P(B|A_2) = .20$

121. The salesperson has just informed us that a cell phone was purchased. What is the probability that customer was female?
Answer: 0.538 based on Bayes theorem.