CHAPTER 4: BASIC PROBABILITY

1. If two events are collectively exhaustive, what is the probability that one or the other occurs?
   a) 0.
   b) 0.50.
   c) 1.00.
   d) Cannot be determined from the information given.

   ANSWER: c
   TYPE: MC DIFFICULTY: Easy
   KEYWORDS: collectively exhaustive

2. If two events are collectively exhaustive, what is the probability that both occur at the same time?
   a) 0.
   b) 0.50.
   c) 1.00.
   d) Cannot be determined from the information given.

   ANSWER: d
   TYPE: MC DIFFICULTY: Moderate
   KEYWORDS: collectively exhaustive, mutually exclusive
   EXPLANATION: We do not know if they are mutually exclusive.

3. If two events are mutually exclusive, what is the probability that one or the other occurs?
   a) 0.
   b) 0.50.
   c) 1.00.
   d) Cannot be determined from the information given.

   ANSWER: d
   TYPE: MC DIFFICULTY: moderate
   KEYWORDS: collectively exhaustive, mutually exclusive
   EXPLANATION: We do not know if they are collectively exhaustive.

4. If two events are mutually exclusive, what is the probability that both occur at the same time?
   a) 0.
   b) 0.50.
   c) 1.00.
   d) Cannot be determined from the information given.

   ANSWER: a
   TYPE: MC DIFFICULTY: Easy
   KEYWORDS: mutually exclusive
5. If two events are mutually exclusive and collectively exhaustive, what is the probability that both occur?
   a) 0.
   b) 0.50.
   c) 1.00.
   d) Cannot be determined from the information given.

ANSWER:
   a
   TYPE: MC  DIFFICULTY: Easy
   KEYWORDS: collective exhaustive, mutually exclusive

6. If two events are mutually exclusive and collectively exhaustive, what is the probability that one or the other occurs?
   a) 0.
   b) 0.50.
   c) 1.00.
   d) Cannot be determined from the information given.

ANSWER:
   c
   TYPE: MC  DIFFICULTY: Easy
   KEYWORDS: collectively exhaustive, mutually exclusive

7. If events A and B are mutually exclusive and collectively exhaustive, what is the probability that event A occurs?
   a) 0.
   b) 0.50.
   c) 1.00.
   d) Cannot be determined from the information given.

ANSWER:
   d
   TYPE: MC  DIFFICULTY: moderate
   KEYWORDS: collectively exhaustive, mutually exclusive
   EXPLANATION: We do not know if they are equally likely events.

8. If two equally likely events A and B are mutually exclusive and collectively exhaustive, what is the probability that event A occurs?
   a) 0.
   b) 0.50.
   c) 1.00.
   d) Cannot be determined from the information given.

ANSWER:
   b
   TYPE: MC  DIFFICULTY: easy
   KEYWORDS: collectively exhaustive, mutually exclusive
9. If two equally likely events A and B are mutually exclusive, what is the probability that event A occurs?
   a) 0.
   b) 0.50.
   c) 1.00.
   d) Cannot be determined from the information given.

   ANSWER: d
   TYPE: MC  DIFFICULTY: moderate
   KEYWORDS: collectively exhaustive, mutually exclusive
   EXPLANATION: We do not know if they are collectively exhaustive.

10. If two equally likely events A and B are collectively exhaustive, what is the probability that event A occurs?
    a) 0.
    b) 0.50.
    c) 1.00.
    d) Cannot be determined from the information given.

    ANSWER: d
    TYPE: MC  DIFFICULTY: moderate
    KEYWORDS: collectively exhaustive, mutually exclusive
    EXPLANATION: We do not know if they are mutually exclusive.

11. Selection of raffle tickets from a large bowl is an example of
    a) simple probability.
    b) sampling without replacement.
    c) subjective probability.
    d) None of the above.

    ANSWER: b
    TYPE: MC  DIFFICULTY: Easy
    KEYWORDS: sampling with replacement, sampling without replacement

12. If two events are independent, what is the probability that they both occur?
    a) 0.
    b) 0.50.
    c) 1.00.
    d) Cannot be determined from the information given.

    ANSWER: d
    TYPE: MC  DIFFICULTY: Moderate
    KEYWORDS: statistical independence

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13. If the outcome of event $A$ is not affected by event $B$, then events $A$ and $B$ are said to be
   a) mutually exclusive.
   b) independent.
   c) collectively exhaustive.
   d) None of the above.

ANSWER: b
TYPE: MC  DIFFICULTY: Easy
KEYWORDS: statistical independence

14. If event $A$ and event $B$ cannot occur at the same time, then events $A$ and $B$ are said to be
   a) mutually exclusive.
   b) independent.
   c) collectively exhaustive.
   d) None of the above.

ANSWER: a
TYPE: MC  DIFFICULTY: Easy
KEYWORDS: mutually exclusive

15. If either event $A$ or event $B$ must occur, then events $A$ and $B$ are said to be
   a) mutually exclusive.
   b) independent.
   c) collectively exhaustive.
   d) None of the above.

ANSWER: c
TYPE: MC  DIFFICULTY: Moderate
KEYWORDS: collectively exhaustive

16. The collection of all possible events is called
   a) a simple probability.
   b) a sample space.
   c) a joint probability.
   d) the null set.

ANSWER: b
TYPE: MC  DIFFICULTY: Moderate
KEYWORDS: sample space
17. All the events in the sample space that are not part of the specified event are called
   a) simple events.
   b) joint events.
   c) the sample space.
   d) the complement of the event.

   ANSWER:
   d
   TYPE: MC  DIFFICULTY: Moderate
   KEYWORDS: sample space, complement

18. Simple probability is also called
   a) marginal probability.
   b) joint probability.
   c) conditional probability.
   d) Bayes' theorem.

   ANSWER:
   a
   TYPE: MC  DIFFICULTY: Easy
   KEYWORDS: marginal probability

19. When using the general multiplication rule, \( P(A \text{ and } B) \) is equal to
   a) \( P(A|B)P(B) \).
   b) \( P(A)P(B) \).
   c) \( P(B)/P(A) \).
   d) \( P(A)/P(B) \).

   ANSWER:
   a
   TYPE: MC  DIFFICULTY: Moderate
   KEYWORDS: multiplication rule

20. A business venture can result in the following outcomes (with their corresponding chance of occurring in parentheses): Highly Successful (10%), Successful (25%), Break Even (25%), Disappointing (20%), and Highly Disappointing (?). If these are the only outcomes possible for the business venture, what is the chance that the business venture will be considered Highly Disappointing?
   a) 10%
   b) 15%
   c) 20%
   d) 25%

   ANSWER:
   c
   TYPE: MC  DIFFICULTY: Easy
   KEYWORDS: marginal probability
21. A survey of banks revealed the following distribution for the interest rate being charged on a home loan (based on a 30-year mortgage with a 10% down payment) on a certain date in the past.

<table>
<thead>
<tr>
<th>Interest Rate</th>
<th>3.20% to 3.29%</th>
<th>3.30% to 3.39%</th>
<th>3.40% to 3.49%</th>
<th>3.50% to 3.59%</th>
<th>3.60% and above</th>
</tr>
</thead>
<tbody>
<tr>
<td>Probability</td>
<td>0.12</td>
<td>0.23</td>
<td>0.24</td>
<td>0.35</td>
<td>0.06</td>
</tr>
</tbody>
</table>

If a bank is selected at random from this distribution, what is the chance that the interest rate charged on a home loan will exceed 3.49%?

a) 0.06
b) 0.41
c) 0.59
d) 1.00

ANSWER: b
TYPE: MC DIFFICULTY: Easy
KEYWORDS: marginal probability, addition rule

22. The employees of a company were surveyed on questions regarding their educational background (college degree or no college degree) and marital status (single or married). Of the 600 employees, 400 had college degrees, 100 were single, and 60 were single college graduates. The probability that an employee of the company is single or has a college degree is:

a) 0.10
b) 0.25
c) 0.667
d) 0.733

ANSWER: d
TYPE: MC DIFFICULTY: Moderate
KEYWORDS: addition rule

23. The employees of a company were surveyed on questions regarding their educational background (college degree or no college degree) and marital status (single or married). Of the 600 employees, 400 had college degrees, 100 were single, and 60 were single college graduates. The probability that an employee of the company is married and has a college degree is:

a) 0.0667
b) 0.567
c) 0.667
d) 0.833

ANSWER: b
TYPE: MC DIFFICULTY: Moderate
KEYWORDS: joint probability

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24. The employees of a company were surveyed on questions regarding their educational background (college degree or no college degree) and marital status (single or married). Of the 600 employees, 400 had college degrees, 100 were single, and 60 were single college graduates. The probability that an employee of the company does not have a college degree is:
   a) 0.10  
   b) 0.33  
   c) 0.67  
   d) 0.75

ANSWER:  
b
TYPE: MC DIFFICULTY: Easy
KEYWORDS: complement

25. The probability that house sales will increase in the next 6 months is estimated to be 0.25. The probability that the interest rates on housing loans will go up in the same period is estimated to be 0.74. The probability that house sales or interest rates will go up during the next 6 months is estimated to be 0.89. The probability that both house sales and interest rates will increase during the next 6 months is:
   a) 0.10  
   b) 0.185  
   c) 0.705  
   d) 0.90

ANSWER:  
a
TYPE: MC DIFFICULTY: Moderate
KEYWORDS: joint probability

26. The probability that house sales will increase in the next 6 months is estimated to be 0.25. The probability that the interest rates on housing loans will go up in the same period is estimated to be 0.74. The probability that house sales or interest rates will go up during the next 6 months is estimated to be 0.89. The probability that neither house sales nor interest rates will increase during the next 6 months is:
   a) 0.11  
   b) 0.195  
   c) 0.89  
   d) 0.90

ANSWER:  
a
TYPE: MC DIFFICULTY: Moderate
KEYWORDS: joint probability, complement
27. The probability that house sales will increase in the next 6 months is estimated to be 0.25. The probability that the interest rates on housing loans will go up in the same period is estimated to be 0.74. The probability that house sales or interest rates will go up during the next 6 months is estimated to be 0.89. The probability that house sales will increase but interest rates will not during the next 6 months is:
   a) 0.065
   b) 0.15
   c) 0.51
   d) 0.89

ANSWER: b
TYPE: MC DIFFICULTY: Difficult
KEYWORDS: joint probability, marginal probability, complement
EXPLANATION: P(H and I) = P(H) + P(I) – P(H or I); P(H and I) + P(H and Not I) = P(H); P(H and Not I) = P(H) – P(H and I)

28. The probability that house sales will increase in the next 6 months is estimated to be 0.25. The probability that the interest rates on housing loans will go up in the same period is estimated to be 0.74. The probability that house sales or interest rates will go up during the next 6 months is estimated to be 0.89. The events increase in house sales and increase in interest rates in the next 6 months are
   a) independent.
   b) mutually exclusive.
   c) collectively exhaustive.
   d) None of the above.

ANSWER: d
TYPE: MC DIFFICULTY: Moderate
KEYWORDS: joint probability, statistical independence
EXPLANATION: They are not statistically independent.

29. The probability that house sales will increase in the next 6 months is estimated to be 0.25. The probability that the interest rates on housing loans will go up in the same period is estimated to be 0.74. The probability that house sales or interest rates will go up during the next 6 months is estimated to be 0.89. The events increase in house sales and no increase in house sales in the next 6 months are
   a) independent.
   b) mutually exclusive.
   c) collectively exhaustive.
   d) (b) and (c)

ANSWER: d
TYPE: MC DIFFICULTY: Moderate
KEYWORDS: mutually exclusive, collectively exhaustive, complement
30. The probability that a new advertising campaign will increase sales is assessed as being 0.80. The probability that the cost of developing the new ad campaign can be kept within the original budget allocation is 0.40. Assuming that the two events are independent, the probability that the cost is kept within budget and the campaign will increase sales is:
   a) 0.20
   b) 0.32
   c) 0.40
   d) 0.88

ANSWER: b
TYPE: MC DIFFICULTY: Easy
KEYWORDS: statistical independence, joint probability, multiplication rule

31. The probability that a new advertising campaign will increase sales is assessed as being 0.80. The probability that the cost of developing the new ad campaign can be kept within the original budget allocation is 0.40. Assuming that the two events are independent, the probability that the cost is kept within budget or the campaign will increase sales is:
   a) 0.20
   b) 0.32
   c) 0.68
   d) 0.88

ANSWER: d
TYPE: MC DIFFICULTY: Easy
KEYWORDS: statistical independence, multiplication rule, addition rule

32. The probability that a new advertising campaign will increase sales is assessed as being 0.80. The probability that the cost of developing the new ad campaign can be kept within the original budget allocation is 0.40. Assuming that the two events are independent, the probability that the cost is not kept within budget or the campaign will not increase sales is:
   a) 0.12
   b) 0.32
   c) 0.68
   d) 0.88

ANSWER: c
TYPE: MC DIFFICULTY: Easy
KEYWORDS: statistical independence, multiplication rule, addition rule, complement
33. The probability that a new advertising campaign will increase sales is assessed as being 0.80. The probability that the cost of developing the new ad campaign can be kept within the original budget allocation is 0.40. Assuming that the two events are independent, the probability that neither the cost is kept within budget nor the campaign will increase sales is:
   a) 0.12
   b) 0.32
   c) 0.68
   d) 0.88

ANSWER: a
TYPE: MC  DIFFICULTY: Easy
KEYWORDS: statistical independence, multiplication rule, joint probability, complement

34. According to a survey of American households, the probability that the residents own 2 cars if annual household income is over $50,000 is 80%. Of the households surveyed, 60% had incomes over $50,000 and 70% had 2 cars. The probability that the residents of a household own 2 cars and have an income over $50,000 a year is:
   a) 0.12
   b) 0.18
   c) 0.22
   d) 0.48

ANSWER: d
TYPE: MC  DIFFICULTY: Moderate
KEYWORDS: joint probability, conditional probability

35. According to a survey of American households, the probability that the residents own 2 cars if annual household income is over $50,000 is 80%. Of the households surveyed, 60% had incomes over $50,000 and 70% had 2 cars. The probability that the residents of a household do not own 2 cars and have an income over $50,000 a year is:
   a) 0.12
   b) 0.18
   c) 0.22
   d) 0.48

ANSWER: a
TYPE: MC  DIFFICULTY: Difficult
KEYWORDS: joint probability, complement, multiplication rule, conditional probability
36. According to a survey of American households, the probability that the residents own 2 cars if annual household income is over $50,000 is 80%. Of the households surveyed, 60% had incomes over $50,000 and 70% had 2 cars. The probability that the residents of a household own 2 cars and have an income less than or equal to $50,000 a year is:
   a) 0.12
   b) 0.18
   c) 0.22
   d) 0.48

ANSWER: c

TYPE: MC  DIFFICULTY: Difficult
KEYWORDS: joint probability, complement, multiplication rule, conditional probability

37. According to a survey of American households, the probability that the residents own 2 cars if annual household income is over $50,000 is 80%. Of the households surveyed, 60% had incomes over $50,000 and 70% had 2 cars. The probability that annual household income is over $50,000 if the residents of a household own 2 cars is:
   a) 0.42
   b) 0.48
   c) 0.50
   d) 0.69

ANSWER: d

TYPE: MC  DIFFICULTY: Difficult
KEYWORDS: Bayes’ theorem, conditional probability

38. According to a survey of American households, the probability that the residents own 2 cars if annual household income is over $50,000 is 80%. Of the households surveyed, 60% had incomes over $50,000 and 70% had 2 cars. The probability that annual household income is over $50,000 if the residents of a household do not own 2 cars is:
   a) 0.12
   b) 0.18
   c) 0.40
   d) 0.70

ANSWER: c

TYPE: MC  DIFFICULTY: Difficult
KEYWORDS: Bayes’ theorem, conditional probability, complement

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39. According to a survey of American households, the probability that the residents own 2 cars if annual household income is over $50,000 is 80%. Of the households surveyed, 60% had incomes over $50,000 and 70% had 2 cars. The probability that the residents do not own 2 cars if annual household income is not over $50,000 is:
   a) 0.12
   b) 0.18
   c) 0.45
   d) 0.70

ANSWER:
   c
   TYPE: MC DIFFICULTY: Difficult
   KEYWORDS: conditional probability, complement

40. A company has 2 machines that produce widgets. An older machine produces 23% defective widgets, while the new machine produces only 8% defective widgets. In addition, the new machine produces 3 times as many widgets as the older machine does. Given that a widget was produced by the new machine, what is the probability it is not defective?
   a) 0.06
   b) 0.50
   c) 0.92
   d) 0.94

ANSWER:
   c
   TYPE: MC DIFFICULTY: Easy
   KEYWORDS: conditional probability, complement

41. A company has 2 machines that produce widgets. An older machine produces 23% defective widgets, while the new machine produces only 8% defective widgets. In addition, the new machine produces 3 times as many widgets as the older machine does. What is the probability that a randomly chosen widget produced by the company is defective?
   a) 0.078
   b) 0.1175
   c) 0.156
   d) 0.310

ANSWER:
   b
   TYPE: MC DIFFICULTY: Moderate
   KEYWORDS: marginal probability
42. A company has 2 machines that produce widgets. An older machine produces 23% defective widgets, while the new machine produces only 8% defective widgets. In addition, the new machine produces 3 times as many widgets as the older machine does. Given a randomly chosen widget was tested and found to be defective, what is the probability it was produced by the new machine?
   a) 0.08
   b) 0.15
   c) 0.489
   d) 0.511

   ANSWER: d
   TYPE: MC  DIFFICULTY: Difficult
   KEYWORDS: Bayes' theorem, conditional probability

SCENARIO 4-1

Mothers Against Drunk Driving is a very visible group whose main focus is to educate the public about the harm caused by drunk drivers. A study was recently done that emphasized the problem we all face with drinking and driving. Four hundred accidents that occurred on a Saturday night were analyzed. Two items noted were the number of vehicles involved and whether alcohol played a role in the accident. The numbers are shown below:

<table>
<thead>
<tr>
<th>Did alcohol play a role?</th>
<th>Number of Vehicles Involved</th>
<th>Totals</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>Yes</td>
<td>50</td>
<td>100</td>
</tr>
<tr>
<td>No</td>
<td>25</td>
<td>175</td>
</tr>
<tr>
<td>Totals</td>
<td>75</td>
<td>275</td>
</tr>
</tbody>
</table>

43. Referring to Scenario 4-1, what proportion of accidents involved more than one vehicle?
   a) 50/400 or 12.5%
   b) 75/400 or 18.75%
   c) 275/400 or 68.75%
   d) 325/400 or 81.25%

   ANSWER: d
   TYPE: MC  DIFFICULTY: Easy
   KEYWORDS: contingency table, empirical classical probability, addition rule
44. Referring to Scenario 4-1, what proportion of accidents involved alcohol and a single vehicle?
   a) $\frac{25}{400}$ or 6.25%
   b) $\frac{50}{400}$ or 12.5%
   c) $\frac{195}{400}$ or 48.75%
   d) $\frac{245}{400}$ or 61.25%

   ANSWER: b
   TYPE: MC  DIFFICULTY: Easy
   KEYWORDS: contingency table, empirical classical probability, joint probability

45. Referring to Scenario 4-1, what proportion of accidents involved alcohol or a single vehicle?
   a) $\frac{25}{400}$ or 6.25%
   b) $\frac{50}{400}$ or 12.5%
   c) $\frac{195}{400}$ or 48.75%
   d) $\frac{245}{400}$ or 61.25%

   ANSWER: c
   TYPE: MC  DIFFICULTY: Easy
   KEYWORDS: contingency table, empirical classical probability, addition rule

46. Referring to Scenario 4-1, given alcohol was involved, what proportion of accidents involved a single vehicle?
   a) $\frac{50}{75}$ or 66.67%
   b) $\frac{50}{170}$ or 29.41%
   c) $\frac{120}{170}$ or 70.59%
   d) $\frac{120}{400}$ or 30%

   ANSWER: b
   TYPE: MC  DIFFICULTY: Easy
   KEYWORDS: contingency table, empirical classical probability, marginal probability

47. Referring to Scenario 4-1, given that multiple vehicles were involved, what proportion of accidents involved alcohol?
   a) $\frac{120}{170}$ or 70.59%
   b) $\frac{120}{230}$ or 52.17%
   c) $\frac{120}{325}$ or 36.92%
   d) $\frac{120}{400}$ or 30%

   ANSWER: c
   TYPE: MC  DIFFICULTY: Easy
   KEYWORDS: contingency table, empirical classical probability, conditional probability, addition rule
48. Referring to Scenario 4-1, given that 3 vehicles were involved, what proportion of accidents involved alcohol?
   a) 20/30 or 66.67%
   b) 20/50 or 40%
   c) 20/170 or 11.77%
   d) 20/400 or 5%

   ANSWER: b
   TYPE: MC  DIFFICULTY: Easy
   KEYWORDS: contingency table, empirical classical probability, conditional probability

49. Referring to Scenario 4-1, given that alcohol was not involved, what proportion of the accidents were single vehicle?
   a) 50/75 or 66.67%
   b) 25/230 or 10.87%
   c) 50/170 or 29.41%
   d) 25/75 or 33.33%

   ANSWER: b
   TYPE: MC  DIFFICULTY: Easy
   KEYWORDS: contingency table, empirical classical probability, conditional probability, complement

50. Referring to Scenario 4-1, given that alcohol was not involved, what proportion of the accidents were multiple vehicle?
   a) 50/170 or 29.41%
   b) 120/170 or 70.59%
   c) 205/230 or 89.13%
   d) 25/230 or 10.87%

   ANSWER: c
   TYPE: MC  DIFFICULTY: Easy
   KEYWORDS: contingency table, empirical classical probability, conditional probability, complement
SCENARIO 4-2

An alcohol awareness task force at a Big-Ten university sampled 200 students after the midterm to ask them whether they went bar hopping the weekend before the midterm or spent the weekend studying, and whether they did well or poorly on the midterm. The following result was obtained.

<table>
<thead>
<tr>
<th></th>
<th>Did Well on Midterm</th>
<th>Did Poorly on Midterm</th>
</tr>
</thead>
<tbody>
<tr>
<td>Studying for Exam</td>
<td>80</td>
<td>20</td>
</tr>
<tr>
<td>Went Bar Hopping</td>
<td>30</td>
<td>70</td>
</tr>
</tbody>
</table>

51. Referring to Scenario 4-2, what is the probability that a randomly selected student who went bar hopping did well on the midterm?
   a) $\frac{30}{100}$ or 30%
   b) $\frac{30}{110}$ or 27.27%
   c) $\frac{30}{200}$ or 15%
   d) $(100/200)*(110/200)$ or 27.50%

ANSWER: a

52. Referring to Scenario 4-2, what is the probability that a randomly selected student did well on the midterm or went bar hopping the weekend before the midterm?
   a) $\frac{30}{200}$ or 15%
   b) $(80+30)/200$ or $(30+80)/200$ or 55%
   c) $(30+70)/200$ or $(70+30)/200$ or 50%
   d) $(80+30+70)/200$ or $(110+100-30)/200$ or 90%

ANSWER: d

53. Referring to Scenario 4-2, what is the probability that a randomly selected student did well on the midterm and also went bar hopping the weekend before the midterm?
   a) $\frac{30}{200}$ or 15%
   b) $(80+30)/200$ or 55%
   c) $(30+70)/200$ or 50%
   d) $(80+30+70)/200$ or 90%

ANSWER: a
54. Referring to Scenario 4-2, the events "Did Well on Midterm" and "Studying for Exam" are
   a) dependent.
   b) mutually exclusive.
   c) collective exhaustive.
   d) None of the above.

   ANSWER: a
   TYPE: MC  DIFFICULTY: Easy
   KEYWORDS: statistical independence, contingency table, empirical classical probability, joint
   probability

55. Referring to Scenario 4-2, the events "Did Well on Midterm" and "Studying for Exam" are
   a) not dependent.
   b) not mutually exclusive.
   c) collective exhaustive.
   d) None of the above.

   ANSWER: b
   TYPE: MC  DIFFICULTY: Easy
   KEYWORDS: contingency table, empirical classical probability, mutually exclusive, joint
   probability

56. Referring to Scenario 4-2, the events "Did Well on Midterm" and "Did Poorly on Midterm" are
   a) dependent.
   b) mutually exclusive.
   c) collective exhaustive.
   d) All of the above.

   ANSWER: d
   TYPE: MC  DIFFICULTY: Easy
   KEYWORDS: statistical independence, mutually exclusive, collective exhaustive, contingency table,
   empirical classical probability, joint probability

57. True or False: When $A$ and $B$ are mutually exclusive, $P(A \text{ or } B)$ can be found by adding $P(A)$
    and $P(B)$.

   ANSWER: True
   TYPE: TF  DIFFICULTY: Easy
   KEYWORDS: mutually exclusive, addition rule

58. True or False: The collection of all the possible events is called a sample space.

   ANSWER: True
   TYPE: TF  DIFFICULTY: Easy
   KEYWORDS: sample space
59. True or False: If $A$ and $B$ cannot occur at the same time they are called mutually exclusive.

**ANSWER:**
True
**TYPE:** TF  **DIFFICULTY:** Easy
**KEYWORDS:** mutually exclusive

60. True or False: If either $A$ or $B$ must occur they are called mutually exclusive.

**ANSWER:**
False
**TYPE:** TF  **DIFFICULTY:** Easy
**KEYWORDS:** mutually exclusive, collective exhaustive

61. True or False: If either $A$ or $B$ must occur they are called collectively exhaustive.

**ANSWER:**
True
**TYPE:** TF  **DIFFICULTY:** Easy
**KEYWORDS:** collective exhaustive

62. True or False: If $P(A) = 0.4$ and $P(B) = 0.6$, then $A$ and $B$ must be collectively exhaustive.

**ANSWER:**
False
**TYPE:** TF  **DIFFICULTY:** Moderate
**KEYWORDS:** collective exhaustive, mutually exclusive

63. True or False: If $P(A) = 0.4$ and $P(B) = 0.6$, then $A$ and $B$ must be mutually exclusive.

**ANSWER:**
False
**TYPE:** TF  **DIFFICULTY:** Moderate
**KEYWORDS:** mutually exclusive

64. True or False: If $P(A \text{ or } B) = 1.0$, then $A$ and $B$ must be mutually exclusive.

**ANSWER:**
False
**TYPE:** TF  **DIFFICULTY:** Moderate
**KEYWORDS:** mutually exclusive, collective exhaustive

65. True or False: If $P(A \text{ or } B) = 1.0$, then $A$ and $B$ must be collectively exhaustive.

**ANSWER:**
True
**TYPE:** TF  **DIFFICULTY:** Moderate
**KEYWORDS:** collective exhaustive
66. True or False: If \( P(A \text{ and } B) = 0 \), then \( A \) and \( B \) must be mutually exclusive.

**ANSWER:**
True
**TYPE:** TF  **DIFFICULTY:** Easy  
**KEYWORDS:** mutually exclusive

67. True or False: If \( P(A \text{ and } B) = 0 \), then \( A \) and \( B \) must be collectively exhaustive.

**ANSWER:**
False
**TYPE:** TF  **DIFFICULTY:** Easy  
**KEYWORDS:** collectively exhaustive, mutually exclusive

68. True or False: If \( P(A \text{ and } B) = 1 \), then \( A \) and \( B \) must be collectively exhaustive.

**ANSWER:**
True
**TYPE:** TF  **DIFFICULTY:** Difficult  
**KEYWORDS:** collective exhaustive

69. True or False: If \( P(A \text{ and } B) = 1 \), then \( A \) and \( B \) must be mutually exclusive.

**ANSWER:**
False
**TYPE:** TF  **DIFFICULTY:** Difficult  
**KEYWORDS:** mutually exclusive, collective exhaustive

70. Suppose \( A \) and \( B \) are independent events where \( P(A) = 0.4 \) and \( P(B) = 0.5 \). Then \( P(A \text{ and } B) = \) __________.

**ANSWER:**
0.2
**TYPE:** FI  **DIFFICULTY:** Easy  
**KEYWORDS:** statistical independence, multiplication rule

71. Suppose \( A \) and \( B \) are mutually exclusive events where \( P(A) = 0.4 \) and \( P(B) = 0.5 \). Then \( P(A \text{ and } B) = \) __________.

**ANSWER:**
0
**TYPE:** FI  **DIFFICULTY:** Easy  
**KEYWORDS:** mutually exclusive, joint probability, multiplication rule

72. Suppose \( A \) and \( B \) are mutually exclusive events where \( P(A) = 0.4 \) and \( P(B) = 0.5 \). Then \( P(A \text{ or } B) = \) __________.

**ANSWER:**
0.9
**TYPE:** FI  **DIFFICULTY:** Easy
73. Suppose $A$ and $B$ are independent events where $P(A) = 0.4$ and $P(B) = 0.5$. Then $P(A \text{ or } B) =$ __________.

**ANSWER:**
0.7
**TYPE:** FI  **DIFFICULTY:** Easy
**KEYWORDS:** statistical independence, addition rule

74. Suppose $A$ and $B$ are events where $P(A) = 0.4$, $P(B) = 0.5$, and $P(A \text{ and } B) = 0.1$. Then $P(A \text{ or } B) =$ __________.

**ANSWER:**
0.8
**TYPE:** FI  **DIFFICULTY:** Easy
**KEYWORDS:** addition rule

75. Suppose $A$ and $B$ are events where $P(A) = 0.4$, $P(B) = 0.5$, and $P(A \text{ and } B) = 0.1$. Then $P(A|B) =$ __________.

**ANSWER:**
0.2
**TYPE:** FI  **DIFFICULTY:** Moderate
**KEYWORDS:** conditional probability

76. Suppose $A$ and $B$ are events where $P(A) = 0.4$, $P(B) = 0.5$, and $P(A \text{ and } B) = 0.1$. Then $P(B|A) =$ __________.

**ANSWER:**
0.25
**TYPE:** FI  **DIFFICULTY:** Moderate
**KEYWORDS:** conditional probability

**SCENARIO 4-3**

A survey is taken among customers of a fast-food restaurant to determine preference for hamburger or chicken. Of 200 respondents selected, 75 were children and 125 were adults. 120 preferred hamburger and 80 preferred chicken. 55 of the children preferred hamburger.

77. Referring to Scenario 4-3, the probability that a randomly selected individual is an adult is __________.

**ANSWER:**
$125/200$ or $62.5$
**TYPE:** FI  **DIFFICULTY:** Moderate
**KEYWORDS:** marginal probability, empirical probability
78. Referring to Scenario 4-3, the probability that a randomly selected individual is an adult or a child is __________.

ANSWER:
200/200 or 100%
TYPE: FI DIFFICULTY: Moderate
KEYWORDS: addition rule, empirical probability

79. Referring to Scenario 4-3, the probability that a randomly selected individual is a child and prefers chicken is __________.

ANSWER:
20/200 or 10%
TYPE: FI DIFFICULTY: Moderate
KEYWORDS: joint probability, multiplication rule, empirical probability

80. Referring to Scenario 4-3, the probability that a randomly selected individual is an adult and prefers chicken is __________.

ANSWER:
60/200 or 30%
TYPE: FI DIFFICULTY: Moderate
KEYWORDS: joint probability, multiplication rule, empirical probability

81. Referring to Scenario 4-3, the probability that a randomly selected individual is a child or prefers hamburger is __________.

ANSWER:
140/200 or 70%
TYPE: FI DIFFICULTY: Moderate
KEYWORDS: empirical probability, addition rule

82. Referring to Scenario 4-3, assume we know the person is a child. The probability that this individual prefers hamburger is __________.

ANSWER:
55/75 or 73.33%
TYPE: FI DIFFICULTY: Moderate
KEYWORDS: conditional probability, empirical probability

83. Referring to Scenario 4-3, assume we know that a person prefers chicken. The probability that this individual is an adult is __________.

ANSWER:
60/80 or 75%
TYPE: FI DIFFICULTY: Moderate
KEYWORDS: Bayes’ theorem, empirical classical probability, conditional probability
84. Referring to Scenario 4-3, assume we know that a person prefers hamburger. The probability that this individual is a child is ________.

ANSWER:
55/120 or 45.83%
TYPE: FI DIFFICULTY: Moderate
KEYWORDS: Bayes’ theorem, conditional probability, empirical classical probability

SCENARIO 4-4

Suppose that patrons of a restaurant were asked whether they preferred water or whether they preferred soda. 70% said that they preferred water. 60% of the patrons were male. 80% of the males preferred water.

85. Referring to Scenario 4-4, the probability a randomly selected patron prefers soda is ________.

ANSWER:
0.30
TYPE: FI DIFFICULTY: Moderate
KEYWORDS: addition rule, multiplication rule, marginal probability

86. Referring to Scenario 4-4, the probability a randomly selected patron is a female is ________.

ANSWER:
0.40
TYPE: FI DIFFICULTY: Moderate
KEYWORDS: addition rule, multiplication rule, marginal probability

87. Referring to Scenario 4-4, the probability a randomly selected patron is a female who prefers soda is ________.

ANSWER:
0.18
TYPE: FI DIFFICULTY: Difficult
KEYWORDS: joint probability, multiplication rule, addition rule

88. Referring to Scenario 4-4, the probability a randomly selected patron is a female who prefers water is ________.

ANSWER:
0.22
TYPE: FI DIFFICULTY: Difficult
KEYWORDS: joint probability, addition rule, multiplication rule
89. Referring to Scenario 4-4, suppose a randomly selected patron prefers soda. Then the probability
the patron is a male is __________.

ANSWER:
0.40
TYPE: FI DIFFICULTY: Difficult
KEYWORDS: Bayes’ theorem, conditional probability, addition rule, multiplication rule

90. Referring to Scenario 4-4, suppose a randomly selected patron prefers water. Then the
probability the patron is a male is __________.

ANSWER:
0.69
TYPE: FI DIFFICULTY: Difficult
KEYWORDS: addition rule, multiplication rule, conditional probability

91. Referring to Scenario 4-4, suppose a randomly selected patron is a female. Then the probability
the patron prefers water is __________.

ANSWER:
0.55
TYPE: FI DIFFICULTY: Difficult
KEYWORDS: Bayes’ theorem, addition rule, multiplication rule, conditional probability

92. True or False: Referring to Scenario 4-4, the two events "preferring water" and "preferring soda"
are independent.

ANSWER:
False
TYPE: TF DIFFICULTY: Moderate
KEYWORDS: statistical independence, addition rule, multiplication rule

93. True or False: Referring to Scenario 4-4, the two events "preferring water" and “being a male”
are independent.

ANSWER:
False
TYPE: TF DIFFICULTY: Moderate
KEYWORDS: statistical independence, addition rule, multiplication rule
SCENARIO 4-5

In a meat packaging plant Machine A accounts for 60% of the plant's output, while Machine B accounts for 40% of the plant's output. In total, 4% of the packages are improperly sealed. Also, 3% of the packages are from Machine A and are improperly sealed.

94. Referring to Scenario 4-5, if a package is selected at random, the probability that it will be properly sealed is ________.

ANSWER:
0.96
TYPE: FI DIFFICULTY: Moderate
KEYWORDS: addition rule, marginal probability

95. Referring to Scenario 4-5, if a package selected at random is improperly sealed, the probability that it came from machine A is ________.

ANSWER:
0.75
TYPE: FI DIFFICULTY: Difficult
KEYWORDS: conditional probability

96. Referring to Scenario 4-5, if a package selected at random came from Machine A, the probability that it is improperly sealed is ________.

ANSWER:
0.05
TYPE: FI DIFFICULTY: Difficult
KEYWORDS: conditional probability

97. Referring to Scenario 4-5, if a package selected at random came from Machine B, the probability that it is properly sealed is ________.

ANSWER:
0.975
TYPE: FI DIFFICULTY: Difficult
KEYWORDS: conditional probability, complement, addition rule

98. Referring to Scenario 4-5, if a package selected at random came from Machine B, the probability that it is improperly sealed is ________.

ANSWER:
0.025
TYPE: FI DIFFICULTY: Difficult
KEYWORDS: conditional probability, complement, addition rule
SCENARIO 4-6

At a Texas college, 60% of the students are from the southern part of the state, 30% are from the northern part of the state, and the remaining 10% are from out-of-state. All students must take and pass an Entry Level Math (ELM) test. 60% of the southerners have passed the ELM, 70% of the northerners have passed the ELM, and 90% of the out-of-staters have passed the ELM.

99. Referring to Scenario 4-6, the probability that a randomly selected student is someone from northern Texas who has not passed the ELM is ________.

ANSWER:
0.09
TYPE: FI DIFFICULTY: Difficult
KEYWORDS: joint probability, multiplication rule

100. Referring to Scenario 4-6, the probability that a randomly selected student has passed the ELM is ________.

ANSWER:
0.66
TYPE: FI DIFFICULTY: Difficult
KEYWORDS: marginal probability, multiplication rule, addition rule

101. Referring to Scenario 4-6, if a randomly selected student has passed the ELM, the probability the student is from out-of-state is ________.

ANSWER:
0.136
TYPE: FI DIFFICULTY: Difficult
KEYWORDS: Bayes’ theorem, conditional probability

102. Referring to Scenario 4-6, if a randomly selected student has not passed the ELM, the probability the student is from southern Texas is ________.

ANSWER:
0.706
TYPE: FI DIFFICULTY: Difficult
KEYWORDS: Bayes’ theorem, conditional probability, complement

103. Referring to Scenario 4-6, the probability that a randomly selected student is not from southern Texas and has not passed the ELM is ________.

ANSWER:
0.10
TYPE: FI DIFFICULTY: Difficult
KEYWORDS: joint probability, complement, multiplication rule, addition
104. Referring to Scenario 4-6, if a randomly selected student has not passed the ELM, the probability the student is not from northern Texas is ________.

ANSWER: 0.735
TYPE: FI DIFFICULTY: Difficult
KEYWORDS: Bayes’ theorem, conditional probability, complement, addition rule, multiplication rule

105. Referring to Scenario 4-6, if a randomly selected student is not from southern Texas, the probability the student has not passed the ELM is ________.

ANSWER: 0.25
TYPE: FI DIFFICULTY: Difficult
KEYWORDS: Bayes’ theorem, conditional probability, complement, addition rule, multiplication rule

106. Referring to Scenario 4-6, if a randomly selected student is not from out-of-state, the probability the student has passed the ELM is ________.

ANSWER: 0.633
TYPE: FI DIFFICULTY: Difficult
KEYWORDS: Bayes’ theorem, conditional probability, complement, addition rule, multiplication rule

SCENARIO 4-7

The next state lottery will have the following payoffs possible with their associated probabilities.

<table>
<thead>
<tr>
<th>Payoff</th>
<th>Probability</th>
</tr>
</thead>
<tbody>
<tr>
<td>$2.00</td>
<td>0.0500</td>
</tr>
<tr>
<td>$25.00</td>
<td>0.0100</td>
</tr>
<tr>
<td>$100.00</td>
<td>0.0050</td>
</tr>
<tr>
<td>$500.00</td>
<td>0.0010</td>
</tr>
<tr>
<td>$5,000.00</td>
<td>0.0005</td>
</tr>
<tr>
<td>$10,000.00</td>
<td>0.0001</td>
</tr>
</tbody>
</table>

You buy a single ticket.

107. Referring to Scenario 4-7, the probability that you win any money is ________.

ANSWER: 0.0666
TYPE: FI DIFFICULTY: Easy
KEYWORDS: addition rule, empirical probability
108. Referring to Scenario 4-7, the probability that you win at least $100.00 is ________.

ANSWER:
0.0066
TYPE: FI  DIFFICULTY: Easy
KEYWORDS: addition rule, empirical probability

109. Referring to Scenario 4-7, if you have a winning ticket, the probability that you win at least $100.00 is ________.

ANSWER:
0.10
TYPE: FI  DIFFICULTY: Moderate
KEYWORDS: conditional probability, addition rule, empirical probability

110. The closing price of a company’s stock tomorrow can be lower, higher or the same as today’s closed. Without any prior information that may affect the price of the stock tomorrow, the probability that it will close higher than today’s close is 1/3. This is an example of using which of the following probability approach?
   a) A priori probability
   b) Empirical probability
   c) Subjective probability
   d) Conditional probability

ANSWER:
a
TYPE: MC  DIFFICULTY: Easy
KEYWORDS: a priori probability, empirical probability, subjective probability

111. The closing price of a company’s stock tomorrow can be lower, higher or the same as today’s closing price. Based on the closing price of the stock collected over the last month, 25% of the days the closing price was higher than previous day’s closing price, 45% was lower than previous day’s and 30% was the same as previous day’s. Based on this information, the probability that tomorrow’s closing price will be higher than today’s is 25%. This is an example of using which of the following probability approach?
   a) A priori probability
   b) Empirical probability
   c) Subjective probability
   d) Conditional probability

ANSWER:
b
TYPE: MC  DIFFICULTY: Easy
KEYWORDS: a priori probability, empirical probability, subjective probability
112. The closing price of a company’s stock tomorrow can be lower, higher or the same as today’s closing price. After evaluating all the information available on the company’s fundamentals and the economic environment, an analyst has determined that the probability that tomorrow’s closing price will be higher than today’s is determined to be 25%. This is an example of using which of the following probability approach?
   a) A priori probability
   b) Empirical probability
   c) Subjective probability
   d) Conditional probability

ANSWER: c
TYPE: MC DIFFICULTY: Easy
KEYWORDS: a priori probability, empirical probability, subjective probability

SCENARIO 4-8

According to the record of the registrar’s office at a state university, 35% of the students are freshman, 25% are sophomore, 16% are junior and the rest are senior. Among the freshmen, sophomores, juniors and seniors, the portion of students who live in the dormitory are, respectively, 80%, 60%, 30% and 20%.

113. Referring to Scenario 4-8, what is the probability that a randomly selected student is a freshman who lives in a dormitory?

ANSWER: 0.28
TYPE: PR DIFFICULTY: Easy
KEYWORDS: joint probability, multiplication rule

114. Referring to Scenario 4-8, what is the probability that a randomly selected student is a sophomore who does not live in a dormitory?

ANSWER: 0.1
TYPE: PR DIFFICULTY: Easy
KEYWORDS: joint probability, multiplication rule, complement

115. Referring to Scenario 4-8, what is the probability that a randomly selected student is a junior who does not live in a dormitory?

ANSWER: 0.112
TYPE: PR DIFFICULTY: Easy
KEYWORDS: joint probability, multiplication rule, complement
116. Referring to Scenario 4-8, what is the probability that a randomly selected student is a junior or senior who lives in a dormitory?

**ANSWER:**
0.096
**TYPE:** PR  **DIFFICULTY:** Moderate
**KEYWORDS:** joint probability, multiplication rule, addition rule

117. Referring to Scenario 4-8, what percentage of the students live in a dormitory?

**ANSWER:**
0.526
**TYPE:** PR  **DIFFICULTY:** Easy
**KEYWORDS:** marginal probability, multiplication rule, addition rule

118. Referring to Scenario 4-8, what percentage of the students do not live in a dormitory?

**ANSWER:**
0.474
**TYPE:** PR  **DIFFICULTY:** Easy
**KEYWORDS:** marginal probability, multiplication rule, addition rule

119. Referring to Scenario 4-8, if a randomly selected student lives in the dormitory, what is the probability that the student is a freshman?

**ANSWER:**
0.532
**TYPE:** PR  **DIFFICULTY:** Moderate
**KEYWORDS:** Bayes’ theorem, conditional probability

120. Referring to Scenario 4-8, if a randomly selected student lives in the dormitory, what is the probability that the student is not a freshman?

**ANSWER:**
0.468
**TYPE:** PR  **DIFFICULTY:** Moderate
**KEYWORDS:** Bayes’ theorem, conditional probability, complement, addition rule

121. Referring to Scenario 4-8, if a randomly selected student does not live in the dormitory, what is the probability that the student is a junior or a senior?

**ANSWER:**
0.641
**TYPE:** PR  **DIFFICULTY:** Moderate
**KEYWORDS:** Bayes’ theorem, conditional probability, complement, addition rule
122. Referring to Scenario 4-8, determine whether the class status of a student and whether the student lives in a dormitory are independent.

ANSWER:
Not independent
TYPE: PR DIFFICULTY: Easy
KEYWORDS: statistical independence

SCENARIO 4-9

A survey conducted by the Segal Company of New York found that in a sample of 189 large companies, 40 offered stock options to their board members as part of their non-cash compensation packages. For small- to mid-sized companies, 43 of the 180 surveyed indicated that they offer stock options as part of their noncash compensation packages to their board members.

123. Referring to Scenario 4-9, set up a contingency table.

ANSWER:

<table>
<thead>
<tr>
<th>Company Size</th>
<th>Large</th>
<th>Small-to-midsized</th>
</tr>
</thead>
<tbody>
<tr>
<td>Stock Yes</td>
<td>40</td>
<td>43</td>
</tr>
<tr>
<td>Stock No</td>
<td>149</td>
<td>137</td>
</tr>
<tr>
<td>Total</td>
<td>189</td>
<td>180</td>
</tr>
</tbody>
</table>

124. Referring to Scenario 4-9, if a company is selected at random, what is the probability that the company offered stock options to their board members?

ANSWER:
83/369 = 0.2249 or 22.49%
TYPE: PR DIFFICULTY: Easy
KEYWORDS: marginal probability, contingency table

125. Referring to Scenario 4-9, if a company is selected at random, what is the probability that the company is small to mid-sized and did not offer stock options to their board members?

ANSWER:
137/369 = 0.3713 or 37.13%
TYPE: PR DIFFICULTY: Easy
KEYWORDS: joint probability, contingency table

126. Referring to Scenario 4-9, if a company is selected at random, what is the probability that the company is small to mid-sized or offered stock options to their board members?

ANSWER:
220/369 = 0.5962 or 59.62%
TYPE: PR DIFFICULTY: Easy
KEYWORDS: addition rule, contingency table
127. Referring to Scenario 4-9, if a randomly selected company is a large company, what is the probability that it offered stock options to their board members?

**ANSWER:**
40/189 = 0.2116 or 21.16%

**TYPE:** PR  **DIFFICULTY:** Easy

**KEYWORDS:** conditional probability, contingency table

128. Referring to Scenario 4-9, if a randomly selected company offered stock options to their board members, what is the probability that it is a large company?

**ANSWER:**
40/83 = 0.4819 or 48.19%

**TYPE:** PR  **DIFFICULTY:** Easy

**KEYWORDS:** conditional probability, contingency table

129. Referring to Scenario 4-9, is the size of the company independent of whether stock options are offered to their board members and why?

**ANSWER:**
No, because \( P(\text{stock option}) \) is not equal to \( P(\text{stock option} \mid \text{large}) \)

**TYPE:** PR  **DIFFICULTY:** Moderate

**KEYWORDS:** statistical independence, conditional probability, contingency table

**SCENARIO 4-10**

Are whites more likely to claim bias? It was found that 60% of the workers were white, 30% were black and 10% are other races. Given that a worker was white, the probability that the worker had claimed bias was 30%. Given that a worker was black, the probability that the worker had claimed bias was 40%. Given that a worker was other race, the probability that the worker had claimed bias was 0%.

130. Referring to Scenario 4-10, what is the probability that a randomly selected worker had not claimed bias?

**ANSWER:**
0.7 or 70%

**TYPE:** PR  **DIFFICULTY:** Moderate

**KEYWORDS:** complement, marginal probability, multiplication rule

131. Referring to Scenario 4-10, if a randomly selected worker had claimed bias, what is the probability that the worker is white?

**ANSWER:**
0.6 or 60%

**TYPE:** PR  **DIFFICULTY:** Moderate

**KEYWORDS:** Bayes’ theorem, conditional probability
132. Referring to Scenario 4-10, if a randomly selected worker had not claimed bias, what is the probability that the worker is white?

**ANSWER:**
0.6 or 60%
**TYPE:** PR  **DIFFICULTY:** Moderate
**KEYWORDS:** Bayes’ theorem, conditional probability

133. Referring to Scenario 4-10, what is the probability that a randomly selected worker is white and had claimed bias?

**ANSWER:**
0.18 or 18%
**TYPE:** PR  **DIFFICULTY:** Moderate
**KEYWORDS:** joint probability, multiplication rule

134. Referring to Scenario 4-10, what is the probability that a randomly selected worker is black and had not claimed bias?

**ANSWER:**
0.18 or 18%
**TYPE:** PR  **DIFFICULTY:** Moderate
**KEYWORDS:** joint probability, multiplication rule

135. Referring to Scenario 4-10, what is the probability that a randomly selected worker is black and had not claimed bias or is white and has claimed bias?

**ANSWER:**
0.36 or 36%
**TYPE:** PR  **DIFFICULTY:** Moderate
**KEYWORDS:** joint probability, multiplication rule, addition rule

136. Referring to Scenario 4-10, what is the probability that a randomly selected worker is not black and had not claimed bias?

**ANSWER:**
0.52 or 52%
**TYPE:** PR  **DIFFICULTY:** Moderate
**KEYWORDS:** joint probability, multiplication rule, addition rule

137. Referring to Scenario 4-10, when a randomly selected worker was not white, what is the probability that the worker had not claimed bias?

**ANSWER:**
0.7 or 70%
**TYPE:** PR  **DIFFICULTY:** Moderate
**KEYWORDS:** conditional probability, multiplication rule, addition rule
138. You know that the probability of a randomly selected student will cheat on an exam is 1%. You also know that the probability of a randomly selected student will cheat on an exam knowing that his/her fellow classmate is cheating on the exam is also 1%. Which of the following is true about the event of "the randomly selected student cheating on an exam" and "his/her classmate is cheating on the exam"?
   a) They are mutually exclusive.
   b) They are collectively exhaustive.
   c) They are independent.
   d) None of the above.

ANSWER: c
TYPE: MC  DIFFICULTY: Easy
KEYWORDS: statistical independence

139. True or False: To ethically advertise a school lottery scheme to try to raise money for the athletic department, the organizer of the lottery does not need to explicitly specify the probability of each of the prize in the lottery.

ANSWER: False
TYPE: TF  DIFFICULTY: Easy
KEYWORDS: ethical issues

140. True or False: An investment consultant is recommending a certain class of mutual funds to the clienteles based on its exceptionally high probability of exceptionally high gain. It is an unethical practice to tell the clienteles the probability of a loss in her recommendations.

ANSWER: False
TYPE: TF  DIFFICULTY: Easy
KEYWORDS: ethical issues

141. True or False: An investment consultant is recommending a certain class of mutual funds to the clienteles based on its exceptionally high probability of gain. It is an ethical practice to explain to the clienteles what the basis of her probability estimate is.

ANSWER: True
TYPE: TF  DIFFICULTY: Easy
KEYWORDS: ethical issues

142. True or False: An investment consultant is recommending a certain class of mutual funds to the clienteles based on its exceptionally high probability of gain. It is an ethical practice to explain to the clienteles what the meaning of probability is.

ANSWER: True
TYPE: TF  DIFFICULTY: Easy
KEYWORDS: ethical issues
143. True or False: An investment consultant is recommending a certain class of mutual funds to the clienteles based on its exceptionally high probability of gain. It is an unethical practice not to also recommend a class of mutual funds with an exceptionally high probability of loss.

ANSWER:
False
TYPE: TF DIFFICULTY: Easy
KEYWORDS: ethical issues

SCENARIO 4-11

A sample of 300 adults is selected. The contingency table below shows their registration status and their preferred source of information on current events.

<table>
<thead>
<tr>
<th>Preferred source of information</th>
<th>Television</th>
<th>Newspapers</th>
<th>Radio</th>
<th>Internet</th>
</tr>
</thead>
<tbody>
<tr>
<td>Voting registration status</td>
<td>Registered</td>
<td>45</td>
<td>30</td>
<td>45</td>
</tr>
<tr>
<td>Not registered</td>
<td>35</td>
<td>44</td>
<td>45</td>
<td>20</td>
</tr>
</tbody>
</table>

144. Referring to Scenario 4-11, if an adult is selected at random, what is the probability that he/she prefers to get his/her current information from the internet?

ANSWER:
56/300 = 0.1867 or 18.67%
TYPE: PR DIFFICULTY: Easy
KEYWORDS: marginal probability, contingency table

145. Referring to Scenario 4-11, if an adult is selected at random, what is the probability that he/she is a registered voter?

ANSWER:
156/300 = 0.52 or 52%
TYPE: PR DIFFICULTY: Easy
KEYWORDS: marginal probability, contingency table

146. Referring to Scenario 4-11, if an adult is selected at random, what is the probability that he/she is a registered voter who prefers to get his/her current information from the television?

ANSWER:
45/300 = 0.15 or 15%
TYPE: PR DIFFICULTY: Easy
KEYWORDS: joint probability, contingency table
147. Referring to Scenario 4-11, if an adult is selected at random, what is the probability that he/she is a registered voter who does not prefer to get his/her current information from the internet?

**ANSWER:**

\[ \frac{120}{300} = 0.4 \text{ or } 40\% \]

**TYPE:** PR  **DIFFICULTY:** Moderate  
**KEYWORDS:** joint probability, complement, and addition rule, contingency table

148. Referring to Scenario 4-11, if an adult is selected at random, what is the probability that he/she is a registered voter or prefers to get his/her current information from radio?

**ANSWER:**

\[ \frac{201}{300} = 0.67 \text{ or } 67\% \]

**TYPE:** PR  **DIFFICULTY:** Easy  
**KEYWORDS:** addition rule, contingency table

149. Referring to Scenario 4-11, if an adult is selected at random, what is the probability that he/she is a not a registered voter or does not prefer to get his/her current information from the internet?

**ANSWER:**

\[ \frac{264}{300} = 0.88 \text{ or } 88\% \]

**TYPE:** PR  **DIFFICULTY:** Moderate  
**KEYWORDS:** addition rule, contingency table

150. Referring to Scenario 4-11, if a randomly selected adult is a registered voter, what is the probability that he/she prefers to get his/her current information from the newspapers?

**ANSWER:**

\[ \frac{30}{156} = 0.1923 \text{ or } 19.23\% \]

**TYPE:** PR  **DIFFICULTY:** Easy  
**KEYWORDS:** conditional probability, contingency table

151. Referring to Scenario 4-11, what is the probability that an adult who prefers to get his/her current information from the internet will be a registered voter?

**ANSWER:**

\[ \frac{36}{56} = 0.6429 \text{ or } 64.29\% \]

**TYPE:** PR  **DIFFICULTY:** Easy  
**KEYWORDS:** conditional probability, contingency table

152. Referring to Scenario 4-11, is the preferred source of current information independent of the voting registration status?

**ANSWER:**

No, because \( P(\text{registered}) \) is not equal to \( P(\text{registered} \mid \text{television}) \)

**TYPE:** PR  **DIFFICULTY:** Moderate  
**KEYWORDS:** statistical independence, conditional probability

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SCENARIO 4-12

Jake woke up late in the morning on the day that he has to go to school to take an important test. He can either take the shuttle bus which is usually running late 20% of the time or ride his unreliable motorcycle which breaks down 40% of the time. He decides to toss a fair coin to make his choice.

153. Referring to Scenario 4-12, if Jake, in fact, gets to the test on time, what is the probability that he took the bus?

**ANSWER:**
0.5714 or 57.14%
**TYPE:** PR  **DIFFICULTY:** Moderate
**KEYWORDS:** Bayes’ theorem, conditional probability

154. Referring to Scenario 4-12, if Jake, in fact, gets to the test on time, what is the probability that he rode his bike?

**ANSWER:**
0.4286 or 42.86%
**TYPE:** PR  **DIFFICULTY:** Moderate
**KEYWORDS:** Bayes’ theorem, conditional probability

155. Referring to Scenario 4-12, if Jake is late to the test, what is the probability that he rode his bike?

**ANSWER:**
0.6667 or 66.67%
**TYPE:** PR  **DIFFICULTY:** Moderate
**KEYWORDS:** Bayes’ theorem, conditional probability

156. Referring to Scenario 4-12, if Jake is late to the test, what is the probability that he took the bus?

**ANSWER:**
0.3333 or 33.33%
**TYPE:** PR  **DIFFICULTY:** Moderate
**KEYWORDS:** Bayes’ theorem, conditional probability

157. A new model car from Ford Motor Company offers a keyless entry system that utilizes a four-letter code. How many different possible combinations are there for the code?

**ANSWER:**
456,976
**TYPE:** PR  **DIFFICULTY:** Easy
**KEYWORDS:** counting rule
158. At the International Pancakes Hut, there are 4 different ways to have an egg cooked, 7 different choices of pancakes, 5 different types of syrups and 8 different beverages. How many different ways are there to order an egg, a pancake with a choice of syrup and a beverage?

**ANSWER:**
1,120
**TYPE:** PR  **DIFFICULTY:** Easy  
**KEYWORDS:** counting rule

159. There are 10 finalists at a national dog show. How many different orders of finishing can there be for all the 10 finalists?

**ANSWER:**
3,628,800  
**TYPE:** PR  **DIFFICULTY:** Easy  
**KEYWORDS:** counting rule, permutation

160. Eleven freshmen are to be assigned to eleven empty rooms in a student dormitory. Each room is considered unique so that it matters who is being assigned to which room. How many different ways can those eleven freshmen be allocated?

**ANSWER:**
39,916,800  
**TYPE:** PR  **DIFFICULTY:** Easy  
**KEYWORDS:** counting rule, permutation

161. There are only 4 empty rooms available in a student dormitory for eleven new freshmen. Each room is considered unique so that it matters who is being assigned to which room. How many different ways can those 4 empty rooms be filled one student per room?

**ANSWER:**
7,920  
**TYPE:** PR  **DIFFICULTY:** Easy  
**KEYWORDS:** counting rule, permutation

162. There are only 4 empty rooms available in a student dormitory for eleven new freshmen. All the rooms are considered as homogenous so that it does not matter who is being assigned to which room. How many different ways can those 4 empty rooms be filled one student per room?

**ANSWER:**
330  
**TYPE:** PR  **DIFFICULTY:** Easy  
**KEYWORDS:** counting rule, combination
163. Four freshmen are to be assigned to eleven empty rooms in a student dormitory. All the rooms are considered as homogenous so that it does not matter who is being assigned to which room. How many different ways can those 4 freshmen be assigned?

**ANSWER:**
330
**TYPE:** PR  **DIFFICULTY:** Easy
**KEYWORDS:** counting rule, combination

164. There are 47 contestants at a national dog show. How many different ways can contestants fill the first place, second place, and third place positions?

**ANSWER:**
97,290
**TYPE:** PR  **DIFFICULTY:** Easy
**KEYWORDS:** counting rule, permutation

165. Seven passengers are on a waiting list for an overbooked flight. As a result of cancellations, 3 seats become available. How many different ways can those 3 available seats be filled regardless of the order?

**ANSWER:**
35
**TYPE:** PR  **DIFFICULTY:** Easy
**KEYWORDS:** counting rule, combination

166. A high school debate team of 4 is to be chosen from a class of 35. How many possible ways can the team be formed?

**ANSWER:**
52,360
**TYPE:** PR  **DIFFICULTY:** Easy
**KEYWORDS:** counting rule, combination

167. A debate team of 4 is to be chosen from a class of 35. There are two twin brothers in the class. How many possible ways can the team be formed which will include only one of the twin brothers?

**ANSWER:**
10,912
**TYPE:** PR  **DIFFICULTY:** Difficult
**KEYWORDS:** counting rule, combination

168. A debate team of 4 is to be chosen from a class of 35. There are two twin brothers in the class. How many possible ways can the team be formed which will not include any of the twin brothers?

**ANSWER:**
40,920
**TYPE:** PR  **DIFFICULTY:** Moderate
169. A debate team of 4 is to be chosen from a class of 35. There are two twin brothers in the class. How many possible ways can the team be formed which will include both of the twin brothers?

ANSWER: 528

TYPE: PR DIFFICULTY: Moderate
KEYWORDS: counting rule, combination

170. An exploration team of 2 women and 3 men is to be chosen from a candidate pool of 6 women and 7 men. How many different ways can this team of 5 be formed?

ANSWER: 525

TYPE: PR DIFFICULTY: Moderate
KEYWORDS: counting rule, combination

171. Twelve students in a Business Statistics class are to be formed into three teams of four. How many different ways can this be done?

ANSWER: 5,775

TYPE: PR DIFFICULTY: Difficult
EXPLANATION: \( \binom{12}{4,4,4} \left( \frac{8!}{4!4!} \right) \cdot \frac{1}{3!} \)
KEYWORDS: counting rule, combination