NAME ______________________________

Module 20 Solving Problems Using Probability, Statistics, and Discrete Math

Lesson 3 Solving Advanced Probability Problems

independent practice

A jar contains eight green and two yellow marbles.

1. Find the probability of drawing two yellow marbles *without* replacement.
$\frac{2}{10} \cdot \frac{1}{9} = \frac{1}{45}$

2. Find the probability of drawing two yellow marbles *with* replacement.
$\frac{2}{10} \cdot \frac{2}{10} = \frac{4}{100} = \frac{1}{25}$

3. Find the probability of drawing first a green marble and then, a yellow marble *without* replacement. $\frac{8}{10} \cdot \frac{2}{9} = \frac{16}{90} = \frac{8}{45}$

4. Find the probability of drawing first a yellow marble and then, a green marble *without* replacement. $\frac{2}{10} \cdot \frac{8}{9} = \frac{16}{90} = \frac{8}{45}$

5. Find the probability of drawing three yellow marbles *with* replacement. Extend the probability of *two independent events rule:* P(A and B) = P(A) · P(B) to include three independent events P(A and B and C) = P(A) · P(B) · P(C).
$\frac{2}{10} \cdot \frac{2}{10} \cdot \frac{2}{10} = \frac{1}{125}$

The Gray family has decided to have three children. Assume for these problems the probability of having a boy is $\frac{1}{2}$. Determine the probability of each of the outcomes found below for the Gray family. The letters "B" and "G" represent "boy" and "girl." Extend the probability of *two independent events rule*: P(A and B) = P(A) · P(B) to include three independent events P(A and B and C) = P(A) · P(B) · P(C).

6. P(B then B then B)
$\frac{1}{8}$

7. P(B then G then G)
$\frac{1}{8}$

8. P(G then B then G)
$\frac{1}{8}$

9. P(G then G then B)
$\frac{1}{8}$

A counselor selects two students from the school's honor society membership to attend a conference by randomly pulling names from a bowl. The bowl contains the names of five freshmen, four sophomores, six juniors, and five seniors.

10. Find the probability two seniors were chosen.

$\frac{5}{20} \cdot \frac{4}{19} = \frac{1}{19}$

11. Find the probability a freshman and then a sophomore were chosen.

$\frac{5}{20} \cdot \frac{4}{19} = \frac{1}{19}$

12. If the counselor picked an extra name to act as an alternate, find the probability that all three names were juniors. Extend the probability of *two dependent events rule:* P(A then B) = P(A) · P(B after A) to include three dependent events P(A then B then C) = P(A) · P(B after A) · P(C after A and B).

$\frac{6}{20} \cdot \frac{5}{19} \cdot \frac{4}{18} = \frac{1}{57}$

The Libertarian Party has a list of ten candidates, six men and four women, from whom two will be selected to be the Presidential and Vice-Presidential nominees from their party. To answer the following questions, assume the selection of any of the ten candidates is equally likely:

13. Find the probability two women are selected. $\frac{4}{10} \cdot \frac{3}{9} = \frac{12}{90} = \frac{2}{15}$

14. Find the probability two men are selected. $\frac{6}{10} \cdot \frac{5}{9} = \frac{30}{90} = \frac{1}{3}$

15. Find the probability a woman is selected for President and a man for Vice-President. $\frac{4}{10} \cdot \frac{6}{9} = \frac{24}{90} = \frac{4}{15}$

16. Find the probability a man is selected for President, and a woman is selected for Vice-President. $\frac{6}{10} \cdot \frac{4}{9} = \frac{24}{90} = \frac{4}{15}$

17. Examine the answers for Problems 13–16. Which of the four outcomes is most likely? **One third is the largest probability, so a selection of two men is most likely.**

Hector is in gym class and will be randomly assigned a partner for a social dancing lesson. He wants to be partnered with Fiona but is unsure of his chances. He is the second boy to get a partner. There are 15 girls in his class, and each pair will be composed of a boy and a girl.

18. What is the probability the first student gets Fiona, so Hector doesn't?
$\frac{1}{15} \cdot \frac{14}{14} = \frac{1}{15}$

19. What is the probability the first student doesn't get Fiona, but Hector does?
$\frac{14}{15} \cdot \frac{1}{14} = \frac{1}{15}$

20. What is the probability the first student doesn't get Fiona, and Hector doesn't either? $\frac{14}{15} \cdot \frac{13}{14} = \frac{13}{15}$

A scientific calculator requires a logic circuit and a keypad assembly. A factory quality control manager reports that 2% of their logic circuits are defective, and 1% of keypad assemblies are defective. Defects are considered to be independent events.

21. Find the probability both the logic circuit and the keypad assembly of a new calculator will be defective. **(0.02)(0.01) = 0.0002**

22. Find the probability a new calculator will not have a defective logic circuit or a defective keypad assembly. **(0.98)(0.99) = 0.9702**

23. A quality control manager pulled two finished calculators for inspection. What is the probability neither of these calculators will have a defective logic circuit or a defective keypad assembly?

(0.9702)(0.9702) = 0.941288

24. If three logic circuits were randomly selected from the assembly line and tested, what was the probability that all three logic circuits would be free from defects?

(0.98)(0.98)(0.98) = 0.941192

25. What is the probability at least one of the three logic circuits will be defective? Use the answer from Problem 24.

1 − P(all three satisfactory) = 1 − 0.941192 = 0.058808

Journal

1. Explain to a friend the difference between independent and dependent events.
2. Draw a rectangle with a shaded region such that a point in the rectangle has a probability of $\frac{1}{5}$ not being in the shaded region. How do you know you are right?
3. When considering a probability experiment with marble in a bag, explain why it is important to know if the first marble drawn is replaced or not replaced when figuring the probability of the second marble drawn?
4. Reread the directions for Problems 6–9. Kate says that her aunt said, "If a family already has two boys, they will probably have a girl for the third child." Is her aunt right? Explain.
5. Describe a real world problem (different from those in this lesson) that can be solved using either the Independent or Dependent Events Rule. Explain how you know which rule applies.

Cumulative Review

Classify each number as rational, irrational, integer, whole number, or natural number. There will be more than one answer for some problems.

1. 100 **rational, integer, whole, natural**

2. $-\frac{2}{3}$ **rational**

3. 0 **rational, integer, whole, natural**

4. $\sqrt{7}$ **irrational**

Solve each equation for *p*.

5. $|p| = 9$ **$p = -9$ or 9**

6. $|p| + 5 = 2$ **No solution**

7. $2|p| = 12$ **$p = -6$ or 6**

8. $4|p| - 6 = 10$ **$p = -4$ or 4**

Possible Journal Answers

1. When events are independent, the outcome of one doesn't affect the outcome of the other. When the events are dependent, the outcome of one does affect the outcome of the other.

2. The students should draw a rectangle divided into five equal sections and shade four of them. More sections could be drawn so long as $\frac{4}{5}$ of the rectangular region is shaded. The probability of the unshaded part would be one-fifth.

3. When two marbles are drawn from a bag of marbles, if the first marble is replaced before the second marble is drawn, the two draws are independent events. If the first marble is not replaced, the number of marbles in the bag is different from the original number, and the probabilities are different.

4. The probability of having a girl is one-half. It doesn't change. So, having two boys and then a girl or having a girl first does not change the probability of the new baby being a girl. The events are independent.

5. The real world scenarios vary, but the response should include justification for either dependent events (one event affects the probability of the other event) or independent events (one event does NOT affect the probability of the other event).