Carnival Game Tycoon Project
Practice Problems

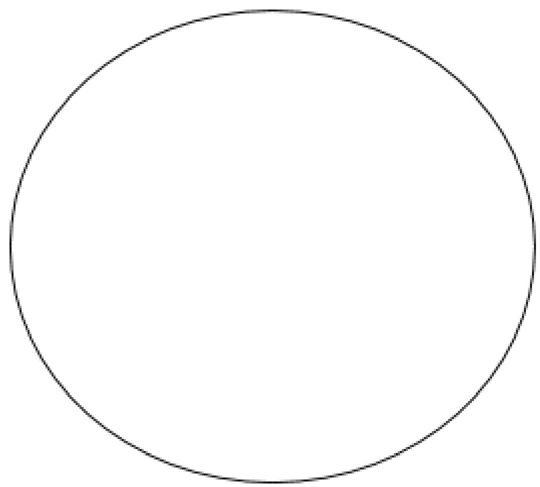
Name:______________________________

Hour:__________

1. Write the formula for **theoretical** probability:

   P (event) =

2. Consider a game that uses a circular spinner with five equal sections. Each section is labeled with the numbers 1-5. Below, use a protractor to draw a picture of the spinner and label each section. Compare with others in the class.



   a. What is the sample space of the spinner? __________________________________

   b. What is the probability of spinning a 2? ________ 3? ________ 5? ________ 0? ________

c. Suppose we perform an experiment. If the spinner is spun 700 times and the spinner lands on **3** a total of 240 times, what is the experimental probability of spinning a 3? ________________________

d. How does the answer for **c** relate to the theoretical probability?

e. Would you consider this spinner to be "fair"? Why or why not?

3. For a certain carnival game, you can win a prize if you throw two darts at the square board pictured below and both darts hit the board. You win a poster for hitting an even number or a CD for hitting the target on two of the same numbers; you win nothing for a single odd number. Each numbered square is the same size, and you may assume that dart hits are spread out evenly and randomly across the entire board.

1	2	3
2	1	3

a. For the target in problem #3, list the following probabilities:

1) Hitting an even number: ____________________

2) Hitting two of the same number: ____________________

3) Hitting an odd number: ____________________

b. What is the total number of outcomes for throwing two darts?

4. Find the following probabilities relating to the dart board. For each problem, assume you hit the board.
   a) P (even number the first dart) =

   b) P (even number, odd number) =

   c) P (even, even) =

   d) P (2,3) =

   e) P (sum of 4) =

   f) P (2,2) =

Carnival Game Tycoon Project
Practice Problems: to accompany lessons 3-4

Name:______________________________

Hour:__________

1. Write the formula for the probability of **independent events** A and B occurring:

   $P(A\ and\ B)\ =$

2. Write the formula for the probability of **dependent events** A and B occurring:

   $P(A\ and\ B)\ =$

3. How do independent events compare with dependent events?

4. You roll two (6-sided) number cubes, a red one and a white one. Find each probability:

   a) P(5,2)

   b) P(5, odd #)

   c) P(3,3)

   d) P(even #, odd #)

   e) P(4,4)

   f) P(less than 5, 6)

5. You have 6 chips numbered 1 through 6 in a cup. You pull one out, then another out without replacing the first one. Find each probability:

a) P(5, 2)

b) P(5, odd #)

c) P(3,3)

d) P(even #, odd #)

e) P(4,4)

f) P(less than 5, 6)

6. Find the probability of each event. Use a standard deck of 52 playing cards.

a) P (heart)

b) P (heart, heart) [without replacement]

c) P (heart, heart, heart) [w/ replacement]

d) P (heart, heart, heart, heart) [w/o replacement]

7. The Stair Game

The game starts on the fifth step of a staircase. Each player's turn consists of flipping two coins and moving up or down according to the following rules. If no heads appear on the player's two coins, the player does not move. If one head appears, the player moves up one stair. If two heads appear, the player moves down one stair.

Before this game is tested as a class, answer the following questions with a partner.

a. Find P (no move) b. Find P (up one) c. Find P (down one)

d. Where would the player expect to be in 8 turns? 40 turns? Answer in terms of movement on the staircase.

e. A staircase has 26 stairs. To win the game, a player must reach the top step. How many turns would you expect it to take for one player to reach the top step when the player starts on the 10^{th}- step? Use words, numbers or diagrams to support your answer.

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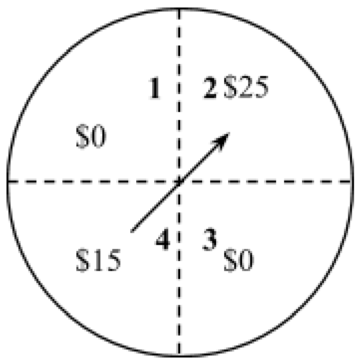
Practice Problems: to accompany lessons 5-6

Hour:__________

The **expected value** of a game is defined as the sum of the products of each value of each outcome and the corresponding probability of the outcome.

Example:



The spinner above has four regions. The spinner is equally likely to land in any region. To find the expected value, follow these steps:

a. For each region, multiply the value of the prize (this example is a dollar amount) by the probability of landing on that prize. Put these values in the blanks.

b. Then add them up.

______________ + ______________ + ______________ + ______________ = ______________
region 1 region 2 region 3 region 4 Expected Value

To qualify for a **fair game**, the cost to play the game would be equal to the expected value. For this game to be fair, the cost to play would be _______________________ .

1. Consier a carnival game in which players win prizes by rolling a cube. The cube has one red side, one white side, one blue side and three green sides. This game costs $1 to play. If the cube stops with the red face up, the player receives a prize worth 50 cents. If it stops with the white face up, the player wins a prize worth $1. If it stops with the blue face up, the prize is worth $1.50. Finally, if the cube stops with any of the green faces up, the player wins nothing.

    a. Verify that the cube game is not mathematically fair by calculating the expected value. Show all work below. (Hint: Include the cost to play in your expected value calculation, with a probability of 1.)

    b. Adjust the cost of playing the game to make it fair; in other words, make the expected value $0.

2. Imagine that you are the manager of a carnival. One of the game operators has designed a new game. In this game, players pick one card out of an ordinary deck of 52 playing cards. An ace wins $10, a face card (K, Q, or J) wins $1, and all other cards win nothing. If the game must be made fair, how much should it cost? Show work below.

3. An extended warranty on a cell phone costs $100 per year. During the year you might not file any claim for repairs or replacement, you might need a $250 repair, or you might need a $750 replacement. The outcomes and probabilities are given below.

Outcomes	-100	250	750
Probabilities	1	0.07	.03

Calculate and interpret the expected value. Determine if this is a good deal for the person who purchases the extended warranty.

4. A carnival operator wants to create a game where the player tosses a ball onto a table filled with squares. If the ball lands on a winning square, the player wins a prize worth $10. All other squares are losing squares: if the ball lands on a losing square, the player gets nothing. The carnival operator wants to have a "fair game", meaning that the expected value (including the cost) is $0. The table has 100 equally-sized squares. If the game costs $2 to play, how many winning squares and losing squares should there be? The probabilities will follow the table below, where x is the number of losing squares and y is the number of winning squares:

Events	Lose $2	Win $0	Win $10
Probability	1	$\frac{x}{100}$	$\frac{y}{100}$

Hint: You can use this expected value equation: $E(g) = 0 = \frac{\$0 * x}{100} + \frac{\$10 * y}{100}$. Try solving for y first, then remember that there must be 100 squares in total. You may need to use the back of this page.