Name _____ Period _____

Probability Lesson 6: Using Tree Diagrams to Represent a Sample Space and to Calculate Probabilities

Example 1: Two nights of Games

Imagine that a family decides to play a game each night. They all agree to spin a 4 colored spinner where each of the four possible outcomes is equally likely each night to randomly determine if they will play a board game (B) or a card game (C). The tree diagram mapping the possible overall outcomes over two consecutive nights will be draw below.

To make a tree diagram, first present all possibilities for the first stage. In this case, Monday.

Monday	Tuesday	Outcome
B		
C		

Then, from each branch of the first stage, attach all possibilities for the second stage, Tuesday. Add this to the diagram above.

Note: If the situation given has more than two stages (ex. Monday, Tuesday), this process would be repeated until all stages have been presented.

1) If BB represents two straight nights of board games, what does CB represent?

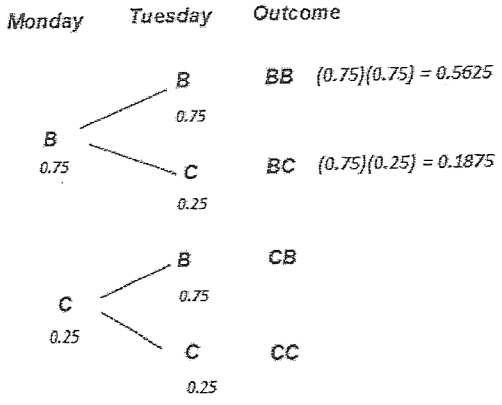
2) List the outcomes where exactly one board game is played over two days. How many outcomes were there?

Example 2: Two Nights of Games (with Probabilites)

In example 1, each night's outcome is the result of a chance experiment (spinning the spinner). So, there is a probability associated with each night's outcome.

By multiplying the probabilities of the outcomes from each stage, we can obtain the probability for each "branch of the tree." In this case, we can figure out the probability of each of our four outcomes: BB, BC, CB, and CC.

For this family, a card game will be played if the spinner lands showing a value of 1, and a board game will be played if the spinner lands showing a value of 2, 3, or 4. This makes the probability of a board game (B) on a given night 0.75.



a. The probabilities for two of the four outcomes are shown. Now, compute the probabilities for the two remaining outcomes.

b. What is the probability that there will be exactly one night of board games over the two nights?

Exercises: Two Children

Two friends meet at a grocery store and remark that a neighboring family just welcomed their second child. It turns out that both children in this family are girls, and they are not twins. One of the friends is curious about what the chances are of having 2 girls in a family's first 2 births. Suppose that for each birth the probability of a boy birth is 0.5 and the probability of a girl birth is also 0.5.

1. Draw a tree diagram demonstrating the four possible birth outcomes for a family with 2 children (no twins). Use the symbol B for the outcome of *boy* and G for the outcome of *girl*. Consider the first birth to be the first stage. (Refer to Example 1 if you need help getting started.)

2. Write in the probabilities of each stage's outcome to the tree diagram you developed above, and determine the probabilities for each of the 4 possible birth outcomes for a family with 2 children (no twins).

3. What is the probability of a family having 2 girls in this situation? Is that greater than or less than the probability of having exactly 1 girl in 2 births?

Exercises:

Each group in class will be assigned one of the situations below. Groups will find the number of possible outcomes for their scenario. In each of these scenarios, the choices are equally likely.

1) Flip a dime and then a nickel

2) A choice of chicken, fish or beef for the main dish and a choice of cake or pudding for dessert

3) A choice of either a green or blue shirt and a choice of blue, black or khaki pants

4) A choice of pizza or spaghetti; a choice of milk or juice to drink; a choice of pudding or an apple for dessert

5) Shirts come in three sizes: small, medium or large; shirts have buttons or snaps; colors are blue or beige

6) The choices for school mascot are lion, bear and porpoise; colors are red, blue and gold

Determine the number of outcomes for your group's situation below:

Fill in your situation (the number of decisions in the first choice times the number of decisions in the second choice) in the table below. Add the data from all the group's situations as well.

Situation	Decisions	Possible Outcomes
1) flip a dime & nickel		
2) choice of chicken . . .		
3) choice of shirt & pants		
4) choice of pizza		
5) Shirt sizes		
6) school mascot . . .		

1) Is there a relationship between the number of decisions to be made and the possible outcomes?

The **Fundamental Counting Principle** tells us that if we have two decisions to make, and there are **M** ways to make the first decision, and **N** ways to make the second decision, the product of **M** and **N** tells us how many different outcomes there are for the overall decision process.

In other words: When a series of decisions are to be made, the product of all the ways to make the individual decisions determines the number of outcomes there are.

Travel Time

A travel agent plans trips for tourists from Chicago to Miami. He gives them three ways to get from town to town: airplane, bus, train. Once the tourists arrive, there are two ways to get to the hotel: hotel van or taxi. The cost of each type of transportation is given in the table below.

Transportation Type	Cost
Airplane	$350
Bus	$150
Train	$225
Hotel Van	$60
Taxi	$40

1. Draw a tree diagram to illustrate the possible choices for the tourists. Determine the cost for each outcome.

2. If these six outcomes are chosen equally by tourists, what is the probability that a randomly selected tourist travel in a bus?

3. What is the probability that a person's trip cost less than $300?

4. What is the probability that a person's trip costs more than $350?

5. If the tourists were flying to New York, the subway would be a third way to get to the hotel. How would this change the number of outcomes? Use the Fundamental Counting Principle to explain your answer.

"Happy Birthday to You"

Andy has asked his girlfriend to make all the decisions for their date on her birthday. She will pick a restaurant and an activity for the date. Andy will choose a gift for her. The local restaurants include Mexican, Chinese, Seafood, and Italian. The activities she can choose from are Putt-Putt, bowling, and movies. Andy will buy her either candy or flowers.

1. How many outcomes are there for these three decisions? _____
2. Draw a tree diagram to illustrate the choices.

Dinner for Two	Activity Cost for Two	Gift Cost
Mexican - $20	Putt-Putt - $14	Flowers - $25
Chinese - $25	Bowling - $10	Candy - $7
Italian - $15	Movies - $20	

3. If all the possible outcomes are equally likely, what is the probability that the date will cost at least $50?

4. What is the maximum cost for the date?

5. What is the minimum cost for the date?

6. To the nearest dollar, what is the average cost for this date?

7. What is the probability that the date costs exactly $60?

8. What is the probability that the date costs under $40?