Name ____________________

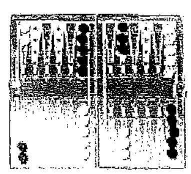
Date ________________

Period ________

Pre-Algebra

Basic Probability

Probability is used all the time in our lives. What is the chance of rain tomorrow? What are the chances of winning the lottery? Do you think we have a chance to win the championship? What are the odds that I will roll a 5? The winner and loser of many games are determined, in part, by chance. For example, in backgammon, each play depends on the roll of the dice. Knowing the probability of rolling a certain number helps determine strategies for future moves.



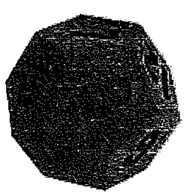
An experiment in probability is an activity in which results are observed. Each observation is called a trial, and each result is called an outcome. The sample space is the set of all possible outcomes of an experiment. An event is any group of outcomes, like will I roll a 5 or will I roll an even number. When all the outcomes are equally likely, it means that all the outcomes have the same chance of happening. When all the outcomes are equally likely, we say the event is taking place "at random."

When this happens, the probability that an event, E, will happen is the following ratio:

P (E) means the Probability that an event E will occur.

$$P(E) = \frac{\text{\# of favorable outcomes}}{\text{Total \# of possible outcomes}}$$

You can write the ratio for a probability as a fraction, a decimal or a percent.



Ex: Find the probability of rolling an even number on a 12

There are 6 favorable outcomes : 2, 4, 6, 8, 10, 12

$$P(E) = \frac{\text{\# of favorable outcomes}}{\text{Total \# of possible outcomes}} = \frac{6}{12} = \frac{1}{2} \text{ or } .5 \text{ or } 50\%$$

Probabilities found by conducting experiments are called experimental probabilities. Probabilities found by counting and classifying all possible outcomes are called theoretical probabilities. For example, if you wanted to know what the probability of getting a sum of 7 when rolling two dice is you could make a chart and show all the possible outcomes(see the table below). There would be 36 possible outcomes of which 6 are equal to 7. Therefore, the theoretical probability is $\frac{6}{36} \text{ or } \frac{1}{6}$ or .17 or 17%.

Now, you and a few friends decide to try this out and see if it really works out to be the same number. So you each roll the dice 50 times and write down the sums that you get. Out of 50 rolls the average times you and your friends got a sum of 7 was 9 times. Therefore, the experimental probability would be $\frac{9}{50}$ = .2 or 20%. The theoretical and experimental turn out to be fairly close.

**Table of Possible Outcomes when rolling two 6-sided dice**

| | 1 | 2 | 3 | 4 | 5 | 6 |
|---|---|---|---|---|---|---|
| 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| 2 | 3 | 4 | 5 | 6 | 7 | 8 |
| 3 | 4 | 5 | 6 | 7 | 8 | 9 |
| 4 | 5 | 6 | 7 | 8 | 9 | 10 |
| 5 | 6 | 7 | 8 | 9 | 10 | 11 |
| 6 | 7 | 8 | 9 | 10 | 11 | 12 |

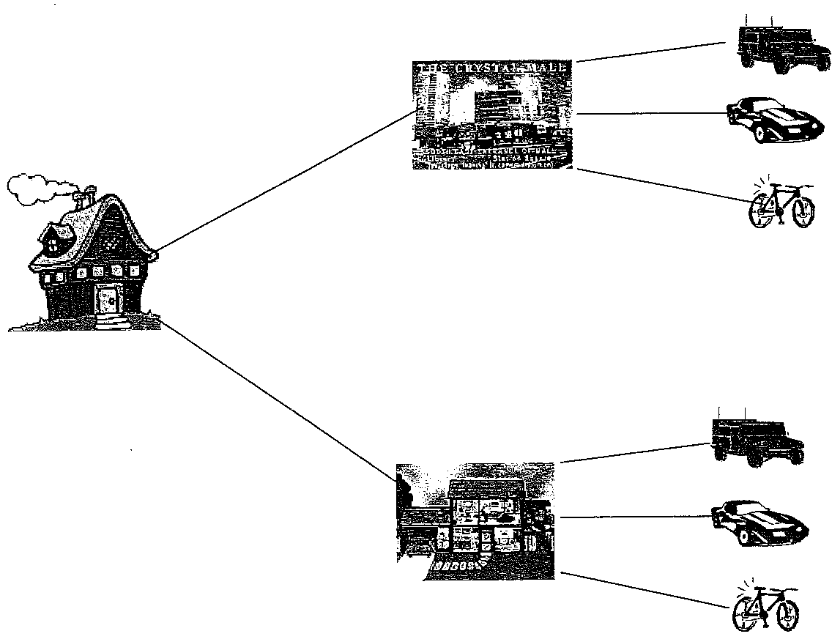
← First Die

Second die →

When you have more than one thing happening, you can make a table or a tree diagram to find the number of outcomes. An example of more than one way that something can happen is:

You could go either to grandma's house or the mall from home by going in Dad's Hummer, Mom's Corvette or by riding your bike.

You could make a tree diagram which is a way of showing all the possible outcomes of an experiment.



When the number of outcomes is very large, you may find it convenient to use the counting principle. The counting principle is the product of the number of outcomes for each stage of the event. For example, in the problem above if you could have been going to grandma's, the mall, the park, the museum, a restaurant, to a friend's or to CVS and you could have gone in the Hummer, the Corvette, your bike, by bus, by train, in the neighbor's Jeep, by walking or in your brother's Volvo, the problem would have been much more complicated and the diagram would be more difficult to make. You would then use the counting principle by multiplying the different events together. You had 7 possible places to go and 8 different means of transportation, so there would be 56 possible outcomes.

Two events are independent if the outcome of one event has no effect on the outcome of the other. Events are dependent if the outcome of the first event affects the outcome of a second event.

Ex: Suppose you have a bag of marbles. There are 4 red ones, 2 blue ones, 3 green and 1 yellow.

What is the probability that you would draw a red marble? $\frac{2}{5}$

The problem changes if:

a) Before you draw out the 2nd marble you drop the 1st one back in the bag (this would be "with replacement") and shake it. What is the probability you draw a red marble on the 2nd draw? It would still be 2 out of 5.

b) Suppose that the first marble you draw is red. Suppose you do NOT put the 1st marble back in the bag (this would be "without replacement"). What is the probability of drawing a red marble on your 2nd draw? It would be 1 out of 3 because there are fewer red ones left in the bag.