# Counting the Possibilities

The points in the coordinate grid on the right show the various outcomes (possibilities) when you roll two dice. For example, the point (1, 4) means that the first die shows 1 and the second die shows 4.

What is the probability of getting the sum of 8 when rolling two dice? The chart helps answer that question. First we find out and count HOW MANY outcomes give you the sum 8:

You could roll 2 & 6, 3 & 5, 4 & 4, 5 & 3, or 6 & 2.

Those number pairs are circled in the second graphic.

So, there are five such possibilities. Therefore, the probability of getting 8 as a sum is 5/36.
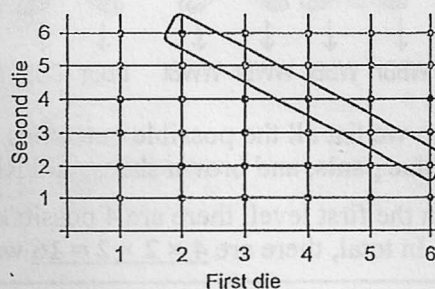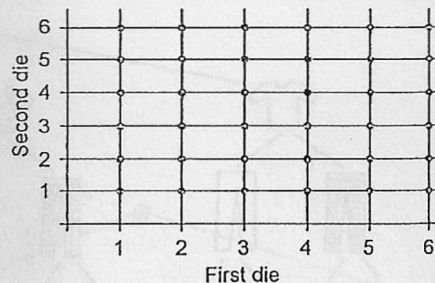
1. a. How many possible outcomes are there, when you roll two dice?

   b. How many outcomes are there for rolling the same number on both dice (such as (5, 5))?

   c. What is the probability of rolling the same number on both dice?
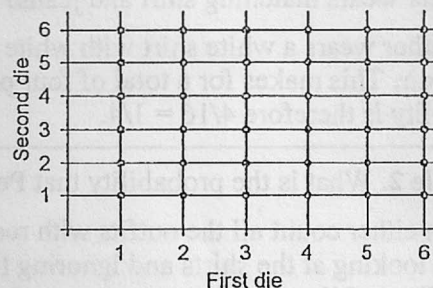
2. a. What is the probability of rolling 5 on the first die and 6 on the second?

   b. What is the probability of rolling 5 on one die and 6 on the other?

   c. What is the probability of getting the sum 7, when rolling two dice?

   d. What is the probability of getting the sum 9, when rolling two dice?

   e. What is the probability of rolling an even number on both dice?

   f. What is the probability of getting at least 6 as a sum, when rolling two dice?

Another common way to represent all the possibilities is a **tree diagram**.

Peter has white, blue, yellow, and red shirt, blue and white pants, and brown and blue tennis shoes. How many possible ways can he make an outfit using them?

outcomes: WBBr WBBl WWBr WWBl BBBr BBBl BWBr BWBl YBBr YBBl YWBr YWBl RBBR RBBl RWBr RWBl
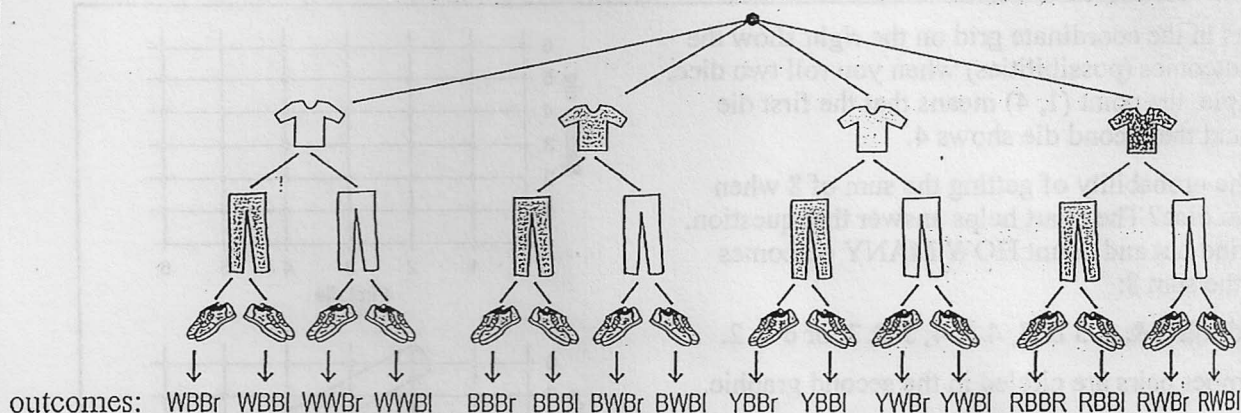
At the bottom we list all the possible outcomes using letter combinations. For example, WBBr means white shirt, blue pants, and brown shoes, and RBBl means red shirt, blue pants, and blue shoes.

Notice that in the first level, there are 4 possibilities, in the second level two, and in the last level 2 possibilities. In total, there are $4 \times 2 \times 2 = 16$ ways he can make an outfit.

Example 1. Peter chooses his shirt, jeans, and shoes randomly. What is the probability that Peter wears matching shirt and jeans?

Peter either wears a white shirt with white pants, or a blue shirt with blue pants. The shoes can be either pair. This makes for a total of four possible outfits: WWBr, WWBl, BBBr, or BBBl. The probability is therefore 4/16 = 1/4.

Example 2. What is the probability that Peter wears a red shirt?

You can either count all the outfits with red shirt (there are four), and get the probability as 4/16 = 1/4, OR just looking at the shirts and ignoring the other clothing items, red shirt is one of the four, so the probability is 1/4.

3. **a.** Complete the tree diagram to show the outcomes when you: First roll a die, then you toss a coin.

b. How many possible outcomes are there for the previous situation?

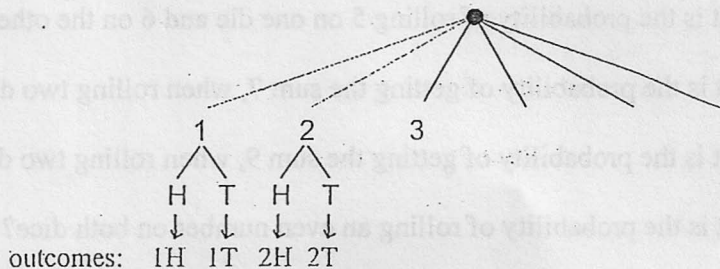**c.** How many ways are there for rolling an even number and getting heads?

d. What is the probability for rolling an even number and getting heads?

outcomes: 1H   1T   2H   2T

e. Find also the following probabilities:

P(3, tails)   P(4 or more, tails)   P(any number, tails)

4. In a multiple choice test, you have four choices for your answer each time.

   a. If the test has two questions, how many possible ways are there to answer?

   b. If the test has five questions, how many possible ways are there to answer?

   c. The test has five questions. Kimberly answers them all randomly.
      What is the probability she gets them all correct?

5. Complete the tree diagram on the right for the following situation:

   A restaurant offers two choices of entrees, three choices of main meal, and two choices of dessert. The entree can either be a soup or salad, the main meal can either be fish, chicken, or beef, and the dessert can either be ice cream or cake.

   If Cindy chooses her entree, main meal and dessert randomly, what is the probability that...
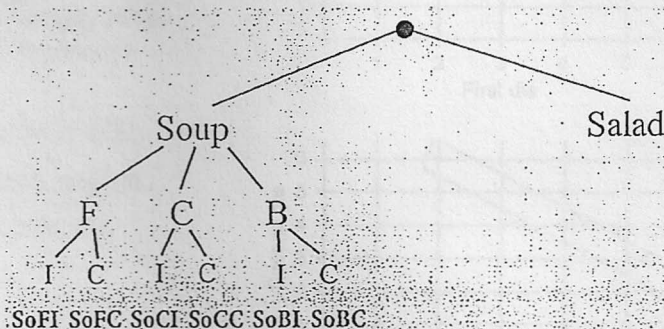
   a. She gets ice cream as dessert.

   b. She has soup, fish, and cake.

   c. She gets soup and fish (and either dessert).

   d. She eats salad and ice cream.

   e. She doesn't eat chicken.

   f. She doesn't eat fish nor ice cream.

6. A cook makes a meal combining fish, chicken, or lamb with either rice, pasta, or potatoes.

   a. How many meal combinations are possible?

   b. The cook chooses the ingredients randomly. What are the probabilities:

   P(lamb with rice)

   P(fish with potatoes)

   P(fish or chicken, with pasta)