4.1 Sample Space and Events

In this chapter we'll consider whether specific events are likely or unlikely.

Definition: The **sample space** is the set of possible outcomes of an experiment. An **event** is a subset of the sample space.

Example: Suppose we roll a (six-sided) die. Let's write out the sample space and some possible events.

experiment

Sample space
$$S = \mathcal{E}_{1/2,3}, 4_1 S, 6$$

Some possible events:

 $E: \text{ noll an even number } E = \{2, 4, 6\}$
 $F: \text{ noll is less than } 3$
 $F = \{1, 2\}$

Example: We toss a coin three times and record heads or tails.

a) Write out the sample space.

$$S= \{HHH, HHT, HTH, THH, THH, THH, THT, TTT\}$$

b) Let E: at most one tail. Write out E.

Example: A small team has four employees named Al, Bo, Cindy and Dan. We want to select two of them for a project.

a) Write out the sample space.

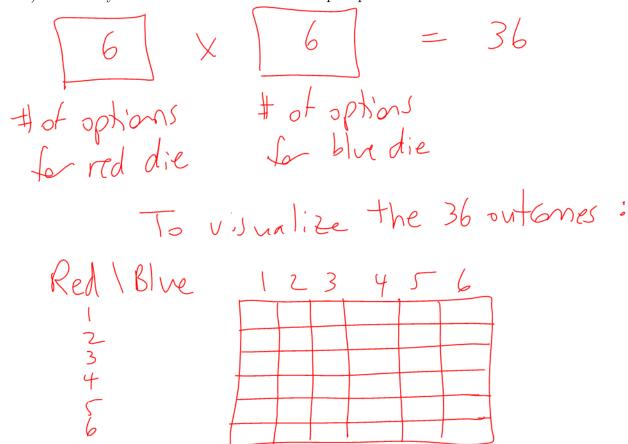
$$S = \{ \{A1, Bo\}, \{A1, (indy)\}, \{A1, Dan\}, \{Bo, (indy)\}, \{Bo, Dan\}, \{(indy), Dan\} \}$$

b) Let E: Al is not chosen. Write out E.

Example: Suppose an experiment has sample space $S = \{1, 2\}$. Write out all the possible events.

Example: We roll a red die and a blue die.

a) How many outcomes are there in the sample space?



b) Let E: the rolls sum to six. Write out E.

 $E = \{ (1,5), (2,4), (3,3), (4,2), (5,1) \}$ red blue

Example: We roll a red die and a blue die.

Let F: the roll on the red die is 4.

Let G: the roll on the red die is 3 or 4, and the roll on the blue die is at least 5.

a) Write out F.

b) Write out G.

c) Find $F \cup G$. Re(a) $F \cup G$: $F \circ G \circ both$

$$F \cup G = \{(3,5),(3,6),(4,1),(4,2),...,(4,6)\}$$

d) Find $F' \cap G$. — means (not F) and G

$$F'_{n}G = \{(3,5),(3,6)\}$$

Definition: Two events E and F are mutually exclusive if $E \cap F = \emptyset$.

Comment: Here are two ways of rephrasing "E and F are mutually exclusive":

"E and F have no outcomes in common"

"E and F can't happen at the same time"

Example: We flip a coin three times. Are the following events mutually exclusive?

a) E: No heads appear.

F: No tails appear.

$$E = (TTT)$$
 $F = \{HHH\}$
 $E \cap F = \emptyset$

Yes, $E \text{ and } F \text{ are multiple}$ exclusive

b) E: At most one tail appears.

F: No tails appear.