Section 4.1 Experiments, Outcomes, Sample Spaces, and Events
Math 141

Main ideas

The **sample space** of an **experiment** is the set of all possible **outcomes** of that experiment.

An **event** is:

A subspace of the sample space (mathematical definition).
A possible outcome that might occur in multiple ways (what that definition means).

All ideas and notation related to sets still applies: **union**, **intersection**, **complement**, etc.

Two sets are **mutually exclusive** if they cannot both occur, i.e. if there is no overlap between them.

Problems

1. Consider the experiment of rolling two dice.

How many possible outcomes are there of rolling two dice? $6 \cdot 6 = 36$

Give the sample space:

$\{1/1, 1/2, \ldots, 1/6,$
$2/1, 2/2, \ldots, 2/6,$
$\vdots$
$6/1, 6/2, \ldots, 6/6\}$

Give the set of outcomes for the event of rolling an odd sum:

$\{1/2, 1/4, 1/6, 2/1, \ldots, 6/3, 6/5\}$

Give the set of outcomes for the event of rolling a sum greater than 9:

$\{4/6, 5/5, 5/6, 6/4, 6/5, 6/6\}$

Give the set of outcomes for the event of rolling doubles:

$\{1/1, \ldots, 6/6\}$

Which event is most likely: odd sum, sum greater than 9, or doubles?

Odd. It can occur in more ways.

Are the events "odd sum" and "sum greater than 9" mutually exclusive?

No. We can have an odd sum > 9.

Are the events "odd sum" and "doubles" mutually exclusive?

Yes. Can't have doubles and have odd sum.

Give the set of outcomes for the event of rolling a difference in the two dice of 1:

$\{1/2, 2/1, 2/3, 3/2, 3/4, 4/3, 4/5, 5/4, 5/6, 6/5\}$

2. Consider the experiment of flipping 3 coins.
How many possible outcomes are there? $2 \cdot 2 \cdot 2 = 8$

Give the sample space:

{HHH, HHT, HTH, THH, HTT, THT, TTH, TTT}

Give the set of outcomes for the event of 2 heads: {HHT, HTH, THH}

Give the set of outcomes for the event of 3 heads: {HHH}

Which do you think is more likely, that 2 of the 3 coins are heads or that all 3 are heads?

2 of 3. It can occur in more ways.

3. An experiment consists of observing the eye color and gender of the students at a certain school. Let E be the event "blue eyes," F the event "male," and G the event "brown eyes and female."

Are E and F mutually exclusive?

No. A person can be both blue eyed and male.

Are E and G mutually exclusive?

Yes. Cannot have blue eyes and brown eyes.

Are F and G mutually exclusive?

Yes. Cannot have both genders.

4. Let E be the event "the car is red"
F be the event "the car is a Chevrolet"
G be the event "the car is a green Ford"
H be the event "the car is black or a Chrysler"

E and F = Red Chevrolet

F and G = ~~[illegible]~~ Chevy and Green Ford: can't happen

F and H = Chevy and (Black or Chrysler): so Black Chevy

E' and G = not Red and Green Ford: so Green Ford

E or F = Red or Chevy

F' = not Chevy

E ∩ H = E and H, so Red and (Black or Chrysler): so Red Chrysler

E' ∪ H' = not E or not H'

so not Red or not (Black or Chrysler)

Easier as (E ∩ H)'

so not Red or (not Black and not Chrysler)