What is Probability?
§4.1

Probability – the likelihood that a certain event will occur.

P(A): "P of A" or "Probability of A"

$0 \leq P \leq 1$ or $0\% \leq P \leq 100\%$

Ways to Compute Probability

1. *Intuition*

Ex. ESPN reports that the Detroit Red Wings have a 70% chance of winning the Stanley Cup.

2. *Relative Frequency:* P(event) = $\frac{f}{n} = \frac{\text{frequency of an event}}{\text{sample size}}$

Ex. The right to health lobby found that out of 100 lab reports, 40 contained errors.

3. Probability Formula: P(event) = $\frac{\text{\# of favorable outcomes}}{\text{total \# of outcomes}}$

Ex. P(heads) = $\frac{1}{2}$; P(rolling a 4) = $\frac{1}{6}$

Law of Large Numbers – as a sample size increases and increases, the relative frequencies of outcomes get closer and closer to the theoretical (or actual) probability.

Sample Space – the set of all possible outcomes of an experiment.

Coin Flip = {heads, tails}
Die Roll = {1, 2, 3, 4, 5, 6}

Complement of an event – 1 – P(A)

If P(blue) = $\frac{2}{7}$, then P(not blue) = $\frac{5}{7}$

Pg 178, 1-10

Compound Events
§4.2 (Day 1)

P(5 on 1^{st} die, 3 on 2^{nd} die)

P(ace on 1^{st} card, ace on 2^{nd} card)

With Replacement: ***Independent***
Without Replacement: ***Dependent***

Independent/Dependent Events
P(A and B) = P(A) • P(B)
P(A, B, and C) = P(A) • P(B) • P(C)

Example 1
Find each using 2 die.
a. P(5, 2)
b. P(3, 3)

Example 2
Find each using one coin.
a. P(H, T)
b. P(T, T, T, T)

Example 3
Find each using a deck of cards without replacement.
a. P(A, K)
b. P(8, 8)

Example 4

If a bag of marbles contains 8 red, 6 blue, 5 green, and 1 yellow, find each without replacement.

a. P(b, y)

b. P(r, g)

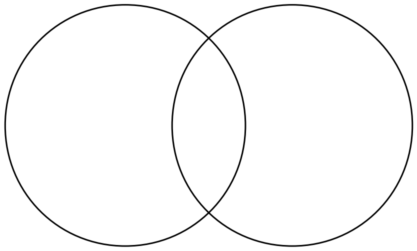
c. P(g, r)

d. P(not r, y)

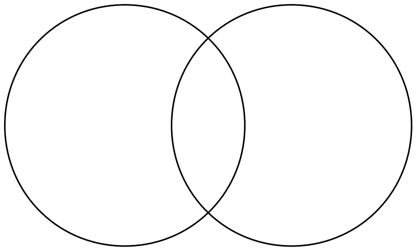
Pg 192, 1c, 2c, 3c, 4acd, 5abc-7abc, 10abc-12abc

Compound Events
§4.2 (Day 2)

P(A and B)



P(A or B)



P(king or dia) =

<u>Mutually exclusive events</u> – events that can not occur at the same time.

Example 1
Determine which are mutually exclusive.
a. drawing a 4, drawing a 6

b. drawing a 4, drawing a club

c. rolling a 5, rolling a 2

d. taking math, taking English.

Mutually Exclusive events A and B
P(A or B) = P(A) + P(B)

Not Mutually Exclusive events A and B
P(A or B) = P(A) + P(B) – P(A and B)

Example 2
Find the following.
a. P(J or A)

b. P(10 or c)

c. P(9 or 10 or J or Q)

d. P(sum of die, 8 or 9 or 10)

Pg 192, 1-3 (a,b), 4b, 5d, 6d, 7-8(a-c), 13, 14ab

Compound Events
§4.2 (Day 3)

A survey was done on employee's political affiliation at a company with the following results:

Type Employee	Democrat (D)	Republican(R)	Ind (I)	**TOTAL**
Executive	5	34	9	**48**
Prod. Worker (PW)	63	21	8	**92**
TOTAL	**68**	**55**	**17**	**140**

Example 1
Find each.
a. P(D)   b. P(E)   c. P(D, given E)

d. P(R, given PW) e. P(D and E)   f. P(D or E)

Pg 196, 19, 24

Trees and Counting Techniques
§4.3 (Day 1)

What if a sample space is not easy to figure out?

Example 1
A college student needs to take Calculus, History, and English their freshman year. There are 4 sections of Calculus, 2 sections of History, and 3 sections of English. How many different schedules are possible?

Is there an easier way for the 24?

Multiplication Rule of Counting – if there are *n* possible outcomes for event E_1 and *m* possible outcomes for event E_2, then the total of
n x *m* or *nm* possible outcomes for the series of events E_1 followed by E_2.

Example 2
A dinner menu gives you a choice of 2 appetizers, 3 salads, 5 main dishes, and 4 desserts. How many possible combinations are there?

Pg 208, 1-4, 7, 8

Trees and Counting Techniques
§4.3 (Day 2)

How many ways exist for 8 people to be seated at a dinner table?

When multiplying in descending order, it is called ***factorial***.

! = factorial
8! = 40, 320

Example 1
Find each.

a. 5!

b. 3!

Counting Rule for Permutations – the number of ways to arrange in order *n* distinct objects, taking *r* at a time is:

$$P_{n,r} = \frac{n!}{(n - r)!}$$

Order is important

Example 2
Find each.

a. $P_{7,3}$

b. $P_{10,6}$

Example 3

If we have 8 people to sit with only 5 chairs and these 5 are to be in a particular order, how many combinations exist?

<u>Counting Rule for Combinations</u> – the number of combinations of *n* objects taken *r* at a time is:

$$C_{n,r} = \frac{n!}{r!(n-r)!}$$

Order not important

<u>Example 4</u>
Find each.

a. $C_{6,2}$

b. $C_{8,5}$

<u>Example 5</u>
Out of 12 people, 3 will go to the convention

Pg 209, 5, 6, 9-19, 20a