Turn in the Check For Understanding Questions in the basket at this time.

and

and pick up the Warm Up

(a) Imagine flipping a fair coin three times. Give a probability model for this chance process and be sure to justify why it is a valid model. [Hint: start by listing the sample space]

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TTT TTH THH HHH
THT HTH
HTT HHT

# Heads	0	1	2	3
Probability	1/8	3/8	3/8	1/8

It's valid because all of the probabilities add up to 1.

(b) Define event A as getting 2 or more heads, event B as getting no heads, and event C as getting at least one head. Find the probability of each of these events.

(c) Are any of these probabilities related?

(b) Define event A as getting 2 or more heads, event B as getting no heads, and event C as getting at least one head. Find the probability of each of these events.

$P(A) = P(\text{2 or more heads}) = \frac{3}{8} + \frac{1}{8} = \frac{3+1}{8} = 4/8$

$P(B) = P(\text{no heads}) = 1/8$

$P(C) = P(\text{at least 1 head}) = \frac{3+3+1}{8} = 7/8$

(c) Are any of these probabilities related?

- The events No heads and at least 1 head are mutually exclusive (can't happen at the same time) so... $P(B \text{ and } C) = 0$

- They are also complementary events so $P(B) = 1 - P(C)$

- Use a two-way table or Venn diagram to model a chance process and calculate probabilities involving two events.
- Apply the general addition rule to calculate probabilities.

$P(A \text{ or } B) = P(A) + P(B)$

that's not it

Stand up
if

- Stand if you are female
- Stand if you are wearing blue jeans
- Stand if you are female **or** wearing blue jeans
- Stand if you are female **and** wearing blue jeans

There are two different uses of the word or in everyday life.

When you are asked if you want "soup or salad," the waiter wants you to choose one or the other, but not both.

However, when you order coffee and are asked if you want "cream or sugar," it's OK to ask for one or the other or both.

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However, when you order coffee and are asked if you want "cream or sugar," it's OK to ask for one or the other or both.

In mathematics and probability, "A or B" means one or the other or both.

Two-Way
TABES
pick up the classwork

How do we find probabilities from a two-way table?

1. Who owns a home? What is the relationship between educational achievement and home ownership? A random sample of 500 people who participated in the 2010 census was chosen. Each member of the sample was identified as a high school graduate (or not) and as a home owner (or not). The two-way table displays the data.

	High school graduate	Not a high school graduate	Total
Homeowner	221	119	340
Not a homeowner	89	71	160
Total	310	190	500

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Homeowner	221	119	340
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Define event A as being a high school graduate. Define event B as being a homeowner. Suppose we choose a member of the sample at random. Find the probability that the member:

(a) is a high school graduate.

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(a) is a high school graduate.

$P(A) = P(\text{high school grad}) = \frac{310}{500}$

	High school graduate	Not a high school graduate	Total
Homeowner	221	119	340
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Total	310	190	500

(b) is a high school graduate and owns a home.

$\frac{221}{500}$

(c) is a high school graduate or owns a home.

(b) is a high school graduate and owns a home.

$P(A \text{ and } B) = P(\text{HS grad and homeowner}) = \frac{221}{500} = .442$

There's about a 44.2% chance that a randomly selected person is both a high school grad and is a homeowner.

(c) is a high school graduate or owns a home.

$P(A \text{ or } B) = P(\text{HS grad or homeowner})$

$= \frac{221 + 89 + 119}{500} = \frac{429}{500}$

$\frac{221}{500} + \frac{89}{500} + \frac{119}{500}$

(d) Explain why $P(A\ or\ B) \neq P(A) + P(B)$

$P(A \text{ and } B) = \frac{221}{500}$

$P(A) + P(B) = \frac{310}{500} + \frac{340}{500}$

Outcomes are double counted

	High school graduate	Not a high school graduate	Total
Homeowner	221	119	340
Not a homeowner	89	71	160
Total	310	190	500

(d) Explain why $P(A \text{ or } B) \neq P(A) + P(B)$

Because the outcomes of $P(A) + P(B)$ are double counted.

Example 2

Preferences

2. Do males and females have a different preference for math or English classes? The two-way table summarizes data about gender and subject preference for a class of 25 AP students.

Preferred subject		Gender: Male	Female	Total
	Math	8	12	20
	English	2	3	5
	Total	10	15	25

Suppose we choose a student from the class at random. Define event D as getting a male student and event E as getting a student who prefers math classes.

a) Find P(D)

10/25 P(male student) =

b) Find P(D and E)

P(male + Prefers Math) = 8/25 = .32

c) Find P(D or E)

P(male student or prefers math) =

$\frac{8}{25} + \frac{12}{25} + \frac{2}{25} = \frac{22}{25}$

Preferred subject		Gender: Male	Female	Total
	Math	8	12	20
	English	2	3	5
	Total	10	15	25

Suppose we choose a student from the class at random. Define event D as getting a male student and event E as getting a student who prefers math classes.

a) Find P(D) $= P(\text{male}) = \frac{10}{25} = 0.4$

		Gender		
		Male	Female	Total
Preferred subject	Math	8	12	20
	English	2	3	5
	Total	10	15	25

b) Find P(D and E)

$= P(\text{male and prefer math}) = \frac{8}{25} = 0.32$

c) Find P(D or E)

$= P(\text{male OR math}) = \frac{2+8+12}{25} = \frac{22}{25} = .88$

also equal to

$P(\text{male}) + P(\text{math}) - P(\text{male and math})$

$= \frac{10}{25} + \frac{20}{25} - \frac{8}{25} = \frac{22}{25}$

$= P(\text{male and prefer math}) = \frac{8}{25} = 0.32$

c) Find P(D or E)

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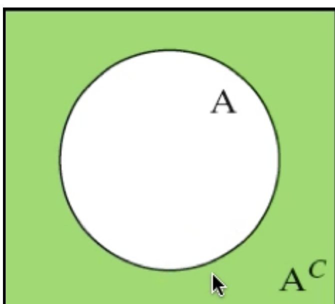
$= \frac{10}{25} + \frac{20}{25} - \frac{8}{25} = \frac{22}{25} = 0.88$

General Addition Rule

Venn Diagrams and Probability

(pages 322-325)

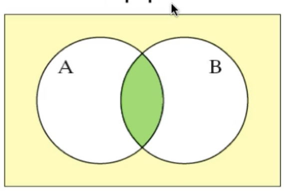


You can see why

P(A) and P(A^C) add up to 1

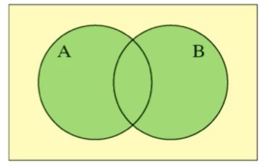
AND

$A \cap B$



OR

$A \cup B$



Intersection

$\cap$

(football)

Union

$\cup$

HINT: To keep the symbols straight, remember

∪ for **U**nion and

∩ for i**n**tersection.

$P(A \cup B)$

and on to
example 3
and 4

3. Where are the best tacos?

A survey of all students at a large high school revealed that, in the last month, 38% of them had dined at Taco Bell, 16% had dined at Chipotle, and 9% had dined at both. Suppose we select a student at random. What's the probability that the student has dined at Taco Bell or Chipotle in the last month?

Now create a **Venn Diagram** to display the sample space in a different way.

3. **Where are the best tacos?**

A survey of all students at a large high school revealed that, in the last month, 38% of them had dined at Taco Bell, 16% had dined at Chipotle, and 9% had dined at both. Suppose we select a student at random. What's the probability that the student has dined at Taco Bell or Chipotle in the last month?

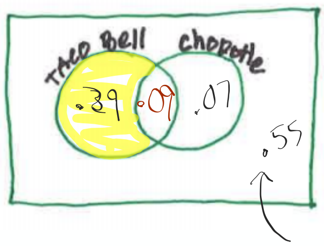
General Addition Rule

= P(Taco Bell OR Chipotle)

= P(Taco Bell) + P(Chipotle) − P(Taco Bell and Chipotle)

= .38 + .16 − .09 = .45

Now create a **Venn Diagram** to display the sample space in a different way.



Left Pacman

Right Pacman

Football

Probability, General Addition Rule, and Venn Diagrams

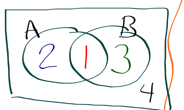
Big Ideas:	
Two way Tables and Venn Diagrams	General Addition Rule

Probability, General Addition Rule, and Venn Diagrams

Big Ideas:

Two way Tables and Venn Diagrams

	B	B^c
A	1	2
A^c	3	4



General Addition Rule

Probability, General Addition Rule, and Venn Diagrams

Big Ideas:

Two way Tables and Venn Diagrams

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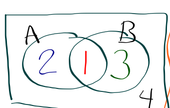


General Addition Rule

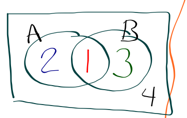
$$P(A \text{ or } B) = P(A) + P(B) - \underbrace{P(A \text{ and } B)}_{\text{overlap}}$$

Probability, General Addition Rule, and Venn Diagrams

Big Ideas:

Two way Tables and Venn Diagrams

	B	B^c
A	1	2
A^c	3	4



General Addition Rule

$P(A \text{ or } B) = P(A) + P(B) - \underbrace{P(A \text{ and } B)}_{\text{overlap}}$

If A and B are mutually exclusive

$P(A \text{ or } B) = P(A) + P(B) = \bigcirc$

no overlap.

Check Your Understanding

Check Your Understanding:

What is the relationship between educational achievement and home ownership? A random sample of 500 U.S. adults was selected. Each member of the sample was identified as a high school graduate (or not) and as a homeowner (or not). The two-way table displays the data. Suppose we choose a member of the sample at random. Define events

G: person is a high school graduate

H: person is a homeowner.

	High school graduate	Not a high school graduate
Homeowner	221	119
Not a homeowner	89	71

1. Explain in plain language what $P(G^c)$ means and find the probability.

2. Explain why $P(G \text{ or } H) \neq P(G) + P(H)$. Then find $P(G \text{ or } H)$.

3. Make a Venn diagram to the right to display the sample space of this chance process.

	High school graduate	Not a high school graduate	
Homeowner	221	119	340
Not a homeowner	89	71	160
	310	190	$\boxed{500}$

1. Explain in plain language what $P(G^C)$ means and find the probability.

The probability the person is not a high school grad.

$$P(G^c) = 190/500 = .38$$

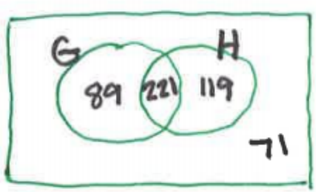
2. Explain why P(G or H) ≠ P(G) + P(H). Then find P(G or H).

There are people who graduated and own a home so they were counted twice.

notice

$$P(G \text{ or } H) = \frac{310 + 340 - 221}{500} = \frac{429}{500} = .858$$

3. Make a Venn diagram to the right to display the sample space of this chance process.



4. Write the event "is not a high school graduate but is a homeowner" in symbolic form and find the probability.

$$P(G^c \cap H) = \frac{119}{500} = .238$$

5.2 .....41, 47, 49, 51, 53, 55-58

and study pp.318-325