5.2 Notes

How can we find probabilities?

Nov 4-2:12 PM

Learning Objectives

1. Sample Space
2. Event
3. Probabilities for a sample space
4. Probability of an event
5. Basic rules for finding probabilities about a pair of events
6. Probability of the union of two events
7. Probability of the intersection of two events

Nov 4-2:12 PM

Compound Events

- only one event
- more than one way/criteria to win

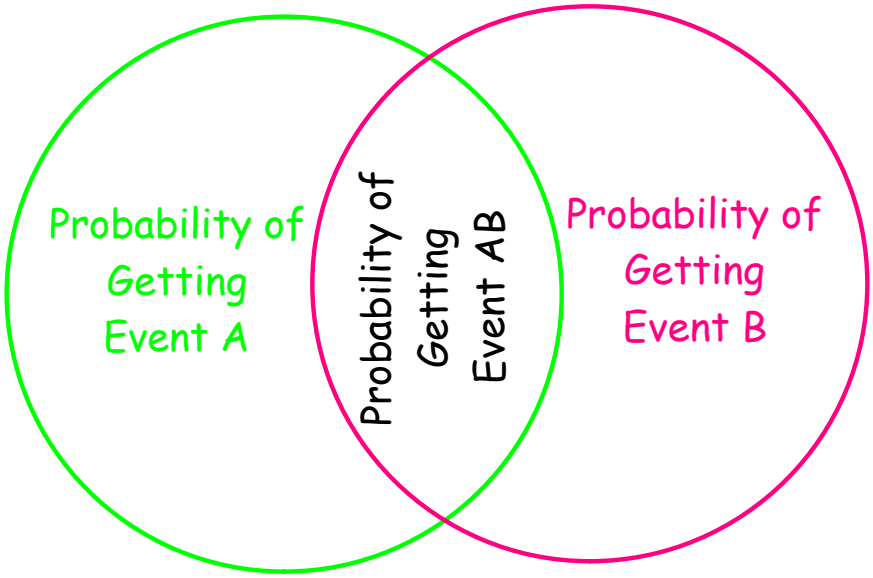
AND
OR

EX/
- Rolling a 1 or a 2
- Drawing a King or a Queen
- Choosing a red or a blue
- Drawing a King and a Heart

Nov 4-2:12 PM

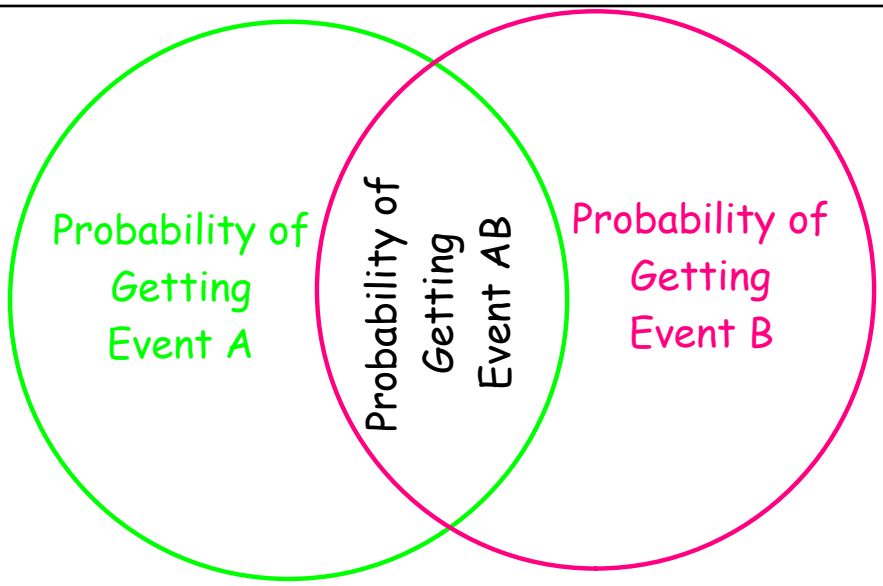
Compound Events

When you have ONE event, use a Venn diagram to calculate the probability



Nov 4-2:12 PM

Compound Events (OR)



P (A or B) = P(A) + P(B) - P(A and B)

overlap

Nov 4-2:12 PM

Practice Example

P(King or Heart)

$P(K \text{ or } \heartsuit) = P(K) + P(\heartsuit) - P(K \text{ and } \heartsuit)$

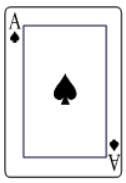
$\frac{4}{52} + \frac{13}{52} - \frac{1}{52} = \frac{16}{52}$

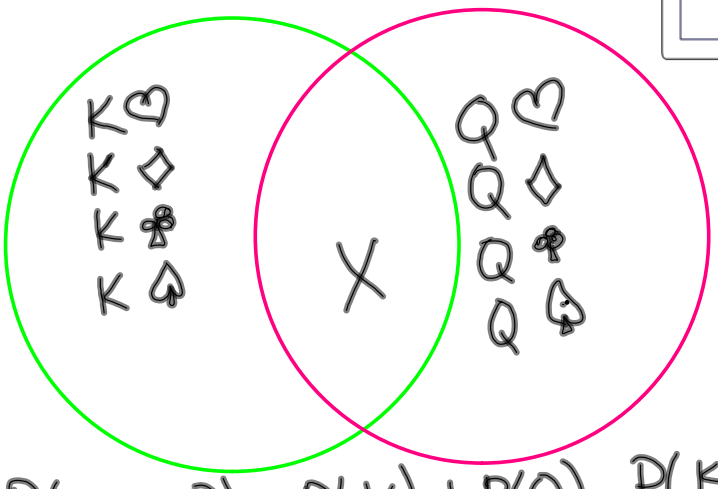
$= .31$

Nov 4-2:12 PM

Practice Example

P(King or Queen)





$P(K \text{ or } Q) = P(K) + P(Q) - P(K \text{ and } Q)$

$\frac{4}{52} + \frac{4}{52} - 0$

$\frac{8}{52} = \frac{2}{13}$

Nov 4-2:12 PM

Practice Example

The probability of event A happening is .5. The probability of event B happening is .4. If the probability that A or B happen is .7, what is P (A and B)?

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

$.7 = .5 + .5 - x$

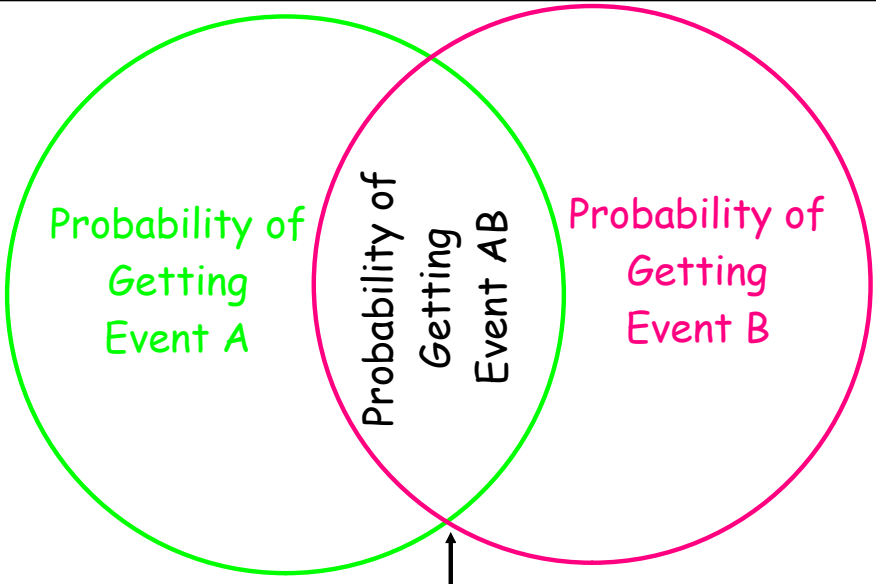
$.7 = .9 - x$

$-.2 = -x$

$P(A \text{ and } B) = .2$

Nov 4-2:12 PM

Compound Events (AND)

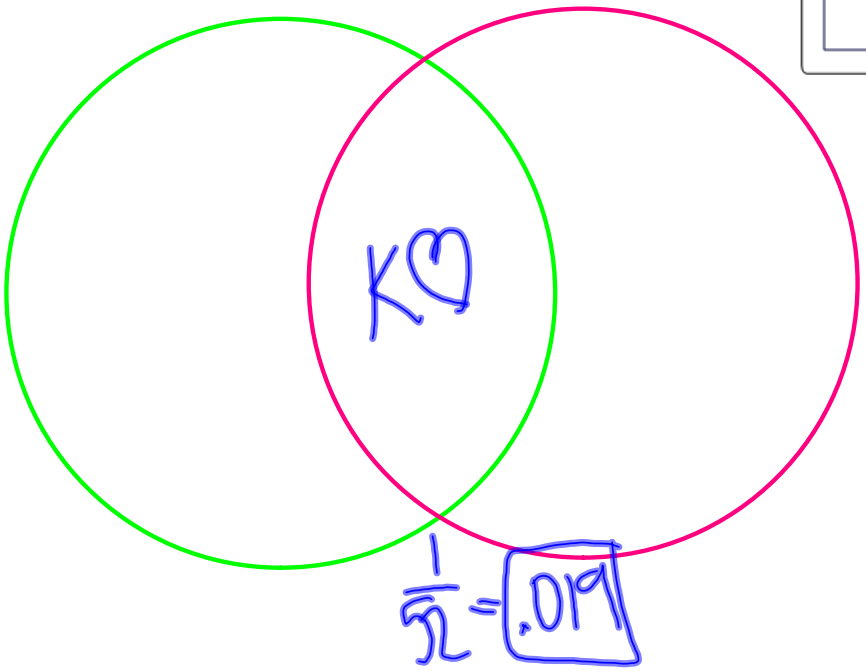


P (A and B) = overlap

Nov 4-2:12 PM

Practice Example

P(King and Heart)



Nov 4-2:12 PM

Mutually Exclusive

The events contain no overlap

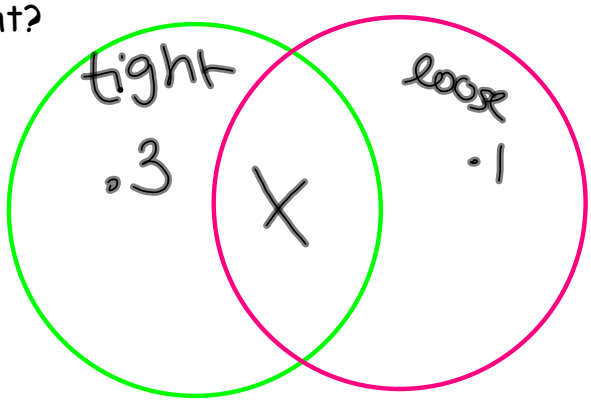
Nov 4-2:12 PM

Practice Example

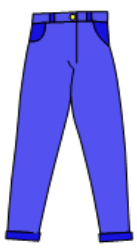
The clothing store carries jeans. If you buy a pair of jeans in regular size without trying them on, the probability that the waist will be too tight is .30 and the probability that the waist will be too loose is .1.

Are these events mutually exclusive? yes

What is the probability the slacks will be too loose or too tight?



.4



Nov 4-2:12 PM

Multi Events

Two or more events following one another

Use Tree Diagram to calculate the probability

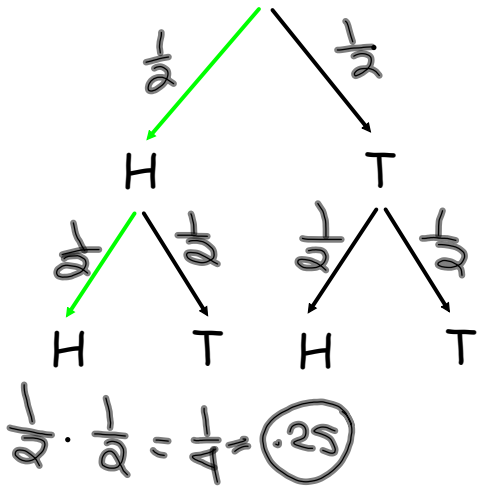
Multiply each probability together "then"

EX/
- cards: P(King followed by a Queen) K then Q
- dice: P(1 then 5)
- coin: P (2 heads in a row) H then H

Nov 4-2:12 PM

Practice Example

P(2 Heads in a row)



$\frac{1}{2} \cdot \frac{1}{2} = \frac{1}{4} = .25$

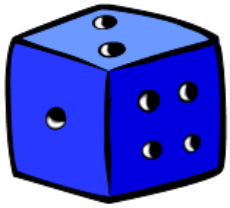
$P(H) \cdot P(H)$

$\frac{1}{2} \cdot \frac{1}{2} = \frac{1}{4} = .25$

Nov 4-2:12 PM

Practice Example

P(1 then 5)



$P(1) \cdot P(5)$

$\frac{1}{6} \cdot \frac{1}{6}$

$\frac{1}{36}$

.028

Nov 4-2:12 PM

Practice Example

P(King followed by Queen)

$P(K) \cdot P(Q)$

$\frac{4}{52} \cdot \frac{4}{52} = \frac{16}{2704} = .0059$

no replacement

$\frac{4}{52} \cdot \frac{4}{51} = \frac{16}{2652} = .006$

Nov 4-2:12 PM

Multi Events

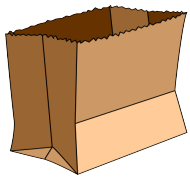
Dependent - the outcome of the second event relies on the outcome of the first event.
(Denominator changes) no replacement

Independent - the outcome of the second event does not rely on the outcome of the first event.
(Denominator stays the same) replacement

Nov 4-2:12 PM

Practice Example

There are 3 blue marbles, 2 pink marbles, and 5 green marbles hidden in a bag.



P(pink) $\frac{2}{10} = .2$

P(pink then blue) *if the first is put back*

$\frac{2}{10} \cdot \frac{3}{10} = \frac{6}{100} = .06$

P(blue then green) *first is not put back*

$\frac{3}{10} \cdot \frac{5}{9} = \frac{15}{90} = .17$

P(blue then blue then green) *no replacement*

$\frac{3}{10} \cdot \frac{2}{9} \cdot \frac{5}{8} = \frac{30}{720} = .042$

Nov 4-2:12 PM

Let's Try Some Problems!

No #5
7b,c

Nov 4-2:12 PM

BELLWORK

1. The chance that a student went to the Homecoming Dance is 0.7, and the chance that a student went to Winter Formal is 0.3. The chance that a student went to both is 0.25. What is the probability that a student went to Homecoming or Winter Formal?

OR: H + W − H&W
.7 + .3 − .25
.75

2. There are 3 red marbles, 5 blue marbles, and 6 yellow marbles in a bag. What's the chance that you draw red then red or you draw yellow then yellow, without replacement?

(14)

$\frac{3}{14} \cdot \frac{2}{13}$ = .033

OR

$\frac{6}{14} \cdot \frac{5}{13}$ = .16

+

.19

Nov 4-2:12 PM

5.2 Practice

1. 7/10 = .7

2. HC, HS, HD, HH, TC, TS, TD, TH

4.

a. .12
b. .1
c. .45
d. .52

Nov 4-2:12 PM

5.2 Practice

6. .5 = .2 + .4 – x ; x = 0.1

7. See below

a. .5 + .4 - .25 = 0.65
b. skip
c. skip

8. $\frac{4}{10}\cdot\frac{3}{9}+\frac{3}{10}\cdot\frac{2}{9}+\frac{3}{10}\cdot\frac{2}{9}=\frac{24}{90}=0.27$

9. No go

Nov 4-2:12 PM

5.2 Practice

10. See below
    a. Independent
    b. Dependent
    c. Independent
    d. Independent

11. $0.56 = .2 + .4 - x$; $x = 0.04$

12. See below
    a. $\frac{8}{20} \cdot \frac{8}{20} \cdot \frac{8}{20} = 0.064$
    b. $\frac{8}{20} \cdot \frac{7}{19} \cdot \frac{6}{18} = 0.049$

13. $0.56 + .61 > 1$, so they must overlap somewhere

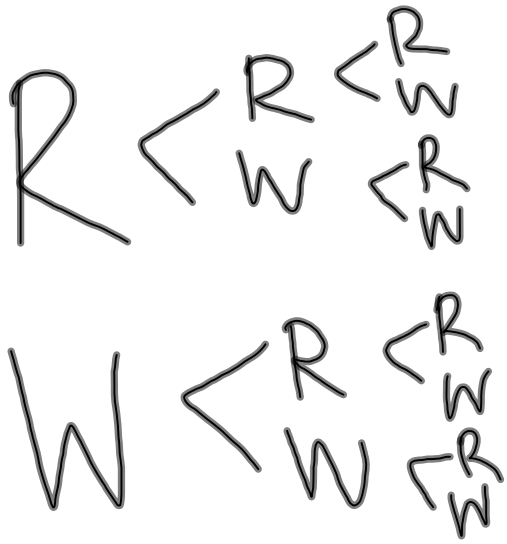
Nov 4-2:12 PM

5.2 Notes Continued

Nov 4-2:12 PM

Practice Problem

What are the possibilities for Right/Wrong combinations that you can have for a 3 questions. (Draw a tree diagram)



RRR $(.2)(.2)(.2) = .008$

RRW $(.2)(.2)(.8) = .032$

RWR .032

RWW .032

WRR

WRW

WWR

WWW

\+

.10

Nov 4-2:12 PM

Complement

The complement of an event, A, consists of all outcomes in the sample space that are not in A

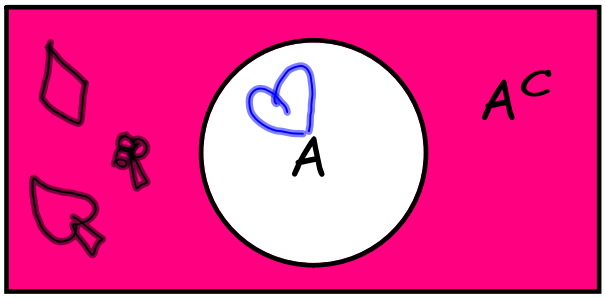
The probabilities of A and A^C add to 1

$P(\heartsuit) = \frac{1}{4} = .25$

$P(A^C) = 1 - P(A)$

$P(\heartsuit^c) = 1 - .25$

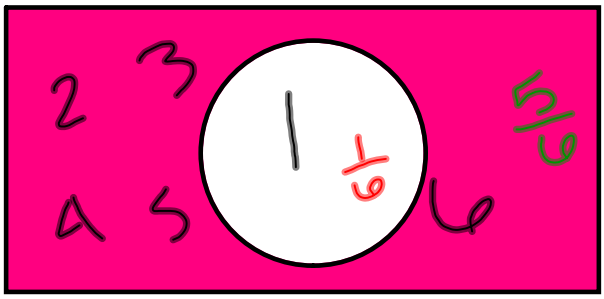
$P(\heartsuit^c) = .75$



Nov 4-2:12 PM

Practice Example

Event A: Rolling a 1
What's A^C



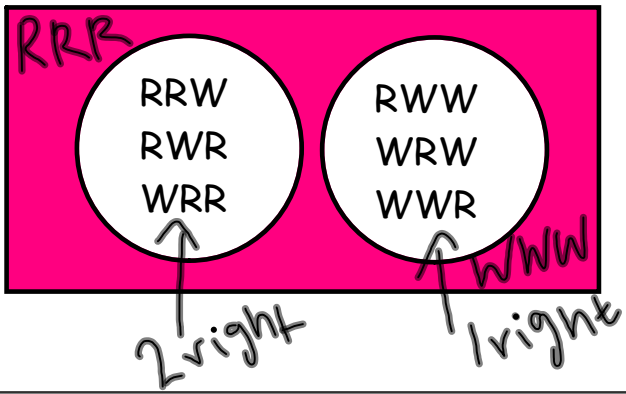
Nov 4-2:12 PM

Disjoint

two events that are disjoint have nothing in common

no overlap!

a.k.a mutually exclusive



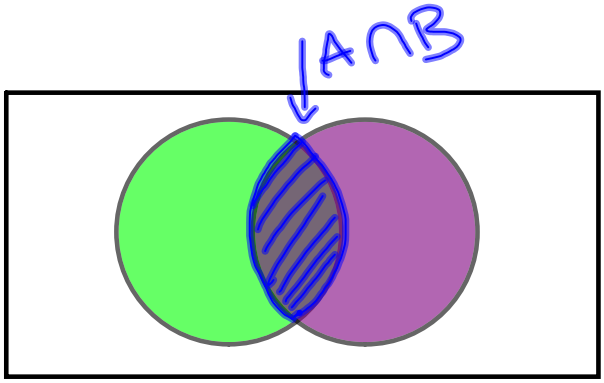
Nov 4-2:12 PM

Intersection

the outcomes that are in both A & B

Overlap "and"

$A \cap B$



Nov 4-2:12 PM

Union

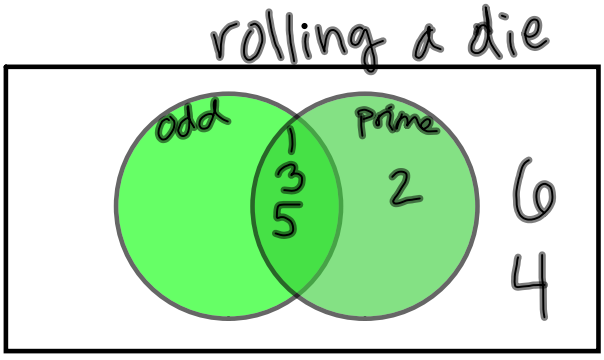
the outcomes that are in A or B or both A & B

$A \cup B$

1,3,5,2

P(AUB)

4/6



Nov 4-2:12 PM

Practice Example

A = being audited
B = income greater than $100,000

P(A and B) $\frac{80}{80200} = .000997\ldots = E^{-4}$

$.000997 \times 10^{-4}$

	WHETHER AUDITED		.0010
Income Level	Yes	No	Total
Under $25,000	90	14010	14100
$25,000–$49,999	71	30629	30700
$50,000–$99,999	69	24631	24700
$100,000 or more	80	10620	10700
Total	310	79890	80200

Nov 4-2:12 PM

Practice Example

Event A = Drawing a spade
Event B = Drawing a 2

$P(2') = 1 - .077$

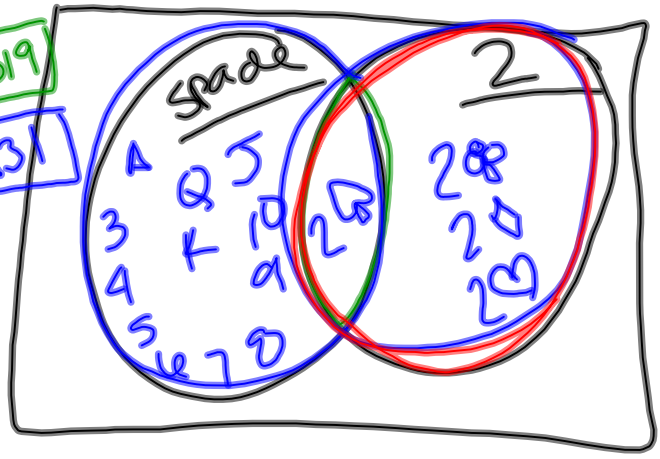
$P(2) = \frac{4}{52} = .077$

P (A ∩ B) $\frac{1}{52} = .019$

P (A ∪ B) $\frac{16}{52} = .31$

P (B^C)

$52 - 4 = \frac{48}{52} = .92$



Nov 4-2:12 PM

Practice Example

If P(guessing correct) = .2 , then what is P(guessing wrong)?

What is the probability that student guesses at least 2 questions correct?

Nov 4-2:12 PM

Multiplication Rule

If two events, A and B, are independent

P(A and B) = P(A) x P(B)

↑ overlap ↑ P(A then B)

↳ Prove independence

Nov 4-2:12 PM

Proving Independence

If A and B are independent then:

P(A and B) = P(A) x P(B)

Nov 4-2:12 PM

Practice Example

A = 1st question answered correctly
B = 2nd question answered correctly

Are A and B independent? → NO, dependent

$P(A \text{ and } B) = P(A) \times P(B)$

$.58 = .63 \times .69$

$.58 \neq .43$

1st Question	2nd Question: C	2nd Question: I
C	0.58	0.05
I	0.11	0.26

A and B

Nov 4-2:12 PM

Homework:

5.2 Worksheet

Nov 6-9:38 AM