AP Statistics - **5.2 Dice Activity**	Name:
Goal: Understanding basic probability rules.	Date:

Question: When rolling 2 dice what is the probability of getting a 2, 3, … or 12?

- To understand this, we will first do a simulation (STEP 1) and then define the theoretical probability model (STEP 2). Then we will compare our class results with the probability model
- As we proceed through this activity, you will be introduced to basic probability rules and I have provided space for you to take notes. REFER TO PAGE 299

Step 1: Simulation
Roll 2 dice 25 times & record your results below.
Then post to class results & find the class %'s.

2	||
3	||
4	|
5	|||
6	|||
7	||
8	~~||||~~
9	|||
10	|||
11	|
12	
TOTAL	

Step 2: Defining a Probability Model

1. List all the possible outcomes to get each sum. Use (dice1, dice2). **This is called the S or** (Sample Space) S=	**2. Probability of Each Outcome** # Possible outcomes/ Total possible outcomes	Probability (round 3 decimals)
(1,1)	1 / 36	.028
(1,2) (2,1)	2 / 36	.056
(1,3) (2,2) (3,1)	3 / 36	.083
(1,4) (2,3) (3,2) (4,1)	4 / 36	.111
(1,5) (2,4) (3,3) (4,2) (5,1)	5 / 36	.139
(1,6) (2,5) (3,4) (4,3) (5,2) (6,1)	6 / 36	.167
(2,6) (3,5) (4,4) (5,3) (6,2)	5 / 36	.139
(3,6) (4,5) (5,4) (6,3)	4 / 36	.111
(4,6) (5,5) (6,4)	3 / 36	.083
(5,6) (6,5)	2 / 36	.056
36 POSSIBLE OUTCOMES (6,6)	1 / 36	.028
	36 / 36	1.001

DEFINITIONS:

- **Sample Space** (p299) (S) OF A CHANCE PROCESS IS THE SET OF ALL POSSIBLE OUTCOMES.
- **Probability Model** (p299) IS A DESCRIPTION OF SOME CHANCE PROCESS CONSISTS OF
  1) The sample space = S.
  2) A PROBABILITY FOR EACH OUTCOME

See STEP 2 (above)

- **Event** (p300)
  1) AN EVENT IS ANY COLLECTION OF OUTCOMES FOR A CHANCE PROCESS
  2) AN EVENT IS A SUBSET OF THE SAMPLE SPACE.
  3) USE CAPITAL LETTERS TO DENOTE EVENTS.

Find the following Probabilities (give as decimals, round to 2 decimals):

1) The probability of rolling a 5 is .11

2) P(6) = .14 **A probability must be between 0 and 1.**

3) The probability of NOT rolling a 7 is $1 - .167 = .833$

4) $P(8^c) = 1 - .139 = .861$ ***This is the COMPLEMENT rule.***

5) P(9) = .11 $P(9^c) = 1 - .11 = .89$

6) ***Can you possibly roll both a 4 and a 5 at the same time?*** NO

- P(4 and 5)= 0 $P(4 \cap 5) = 0$

$\cap$ means Intersection (AND)

- ***These events are*** mutually exclusive ***; These are also called*** disjoint ***events.***

7) The probability of rolling a 2 or a 3 $.028 + .056 = .084$

8) P(4 or 5)= $P(4) + P(5) = .083 + .119 = .19$ ***This is the*** ADDITION RULE FOR MUTUALLY EXCLUSIVE EVENTS ***rule.***

9) $P(6 \cup 7 \cup 8) =$

$P(6) + P(7) + P(8) = .139 + .167 + .139 = .445$

$\cup$ means Union (OR)

Basic Probability Rules (p301, p302, p304)

1) For any event A, $0 \leq P(A) \leq 1$

2) If S is the sample space in a probability model → $P(S) = 1$

3) $P(A) = $ # of outcomes for event A / Total # outcomes in sample space (S)

4) Complement Rule: $P(A^c) = 1 - P(A)$

5) Mutually Exclusive (disjoint) 2 events are mutually exclusive if they have no outcomes in common and so never can occur

6) Addition Rule for Mutually Exclusive Events: $P(A \text{ or } B) = P(A \cup B) = P(A) + P(B)$

7) General Addition Rule: $P(A \text{ or } B) = P(A \cup B) = P(A) + P(B) - P(A \text{ and } B)$

OR

$P(A) + P(B) - P(A \cap B)$

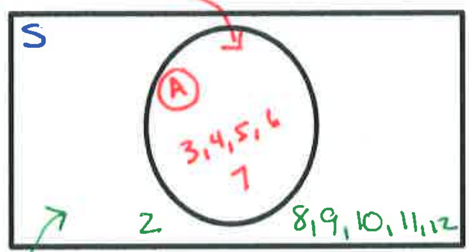
USING VENN DIAGRAMS: **They are very helpful to understand probabilities.**

Let:

- Event A: rolling 2 dice with sums 3-7
- Event B: rolling 2 dice with sums 7-10

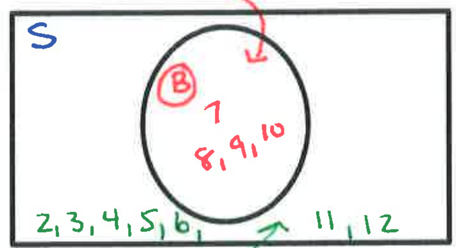
Draw Venn diagrams to find these probabilities:

P(A)= .56

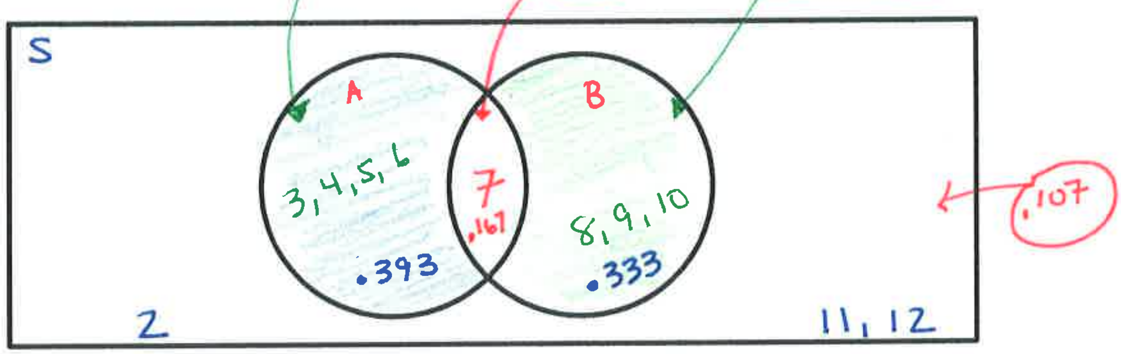


P(A^C)= .44

P(B)= .5



P(B^C)= .5



Draw the Venn Diagram to combine Events A and B and then answer these questions:

1. P(A and B)= P(A ∩ B)= .167 ← P(7)

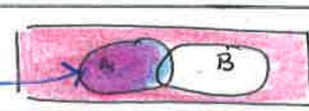
   INTERSECT

2. P(A or B)= P(A U B)= P(A) + P(B) − P(A ∩ B) = .56 + .50 − .167 = .893

   UNION "EVENT A"; "EVENT B", AND "BOTH A and B"

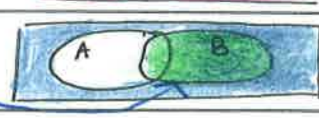
3. P(A and B^C)= .56 − .167 = .393

   ONLY A

4. P(A^C and B)= .50 − .167 = .333

   ONLY B

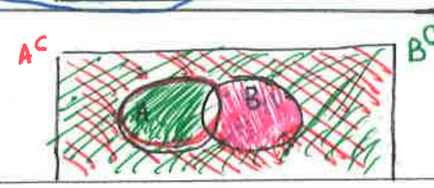
   

5. P(A^C and B^C)= 1 − .393 − .167 − .333 = .107

   INTERSECT

   OUTSIDE BOTH

   CIRCLES

Who Has Pierced Ears? (PAGE 303)

Two-Way Tables and Probability

When finding probabilities involving two events, a two-way table can display the sample space in a way that makes probability calculations easier.

	Pierced Ears?		
Gender	**Yes**	**No**	**Total**
Male	19	71	**90**
Female	84	4	**88**
Total	**103**	**75**	**178**

Define events
***A*: is male and**
***B*: has pierced ears.**

Suppose we choose a student at random. Find the probability that the student

(a) has pierced ears. $P(B) = 103/178 = .579$

(b) is a male with pierced ears. $P(A \text{ and } B) = 19/178 = .107$

* (c) is a male or has pierced ears. $P(A \text{ or } B) = P(A) + P(B) - P(A \text{ and } B) = \frac{90}{178} + \frac{103}{178} - \frac{19}{178} = \frac{174}{178} = .978$

IS THERE A SIMPLIER WAY TO FIND THIS PROBABILITY?

Females w/o pierced ears
complement rule
$1 - 4/178$

Who Has Pierced Ears? (PAGE 303)

- We can use a Venn diagram to display the information and determine probabilities. Fill in the counts:

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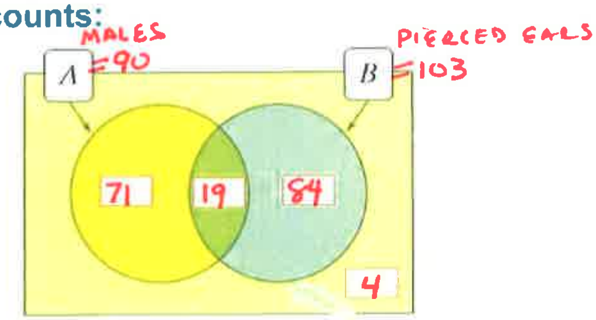

Define events *A*: is male and *B*: has pierced ears.

Region in Venn diagram	In words	In symbols	Count	Probability	
In the intersection of two circles	Male and pierced ears	$P(A \cap B)$	19	$19/178 =$	.107
Inside circle *A*, outside circle *B*	Male and no pierced ears	$P(A \cap B^c)$	71	$71/178 =$	.399
Inside circle *B*, outside circle *A*	Female and pierced ears	$P(A^c \cap B)$	84	$84/178 =$	.472
Outside both circles	Female and no pierced ears	$P(A^c \cap B^c)$	4	$4/178 =$	.022
				$178/178 =$	1.000

Who Has Pierced Ears? **(PAGE 303)**

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(b) is a male with pierced ears.

(c) is a male or has pierced ears.

Who Has Pierced Ears? **(PAGE 303)**

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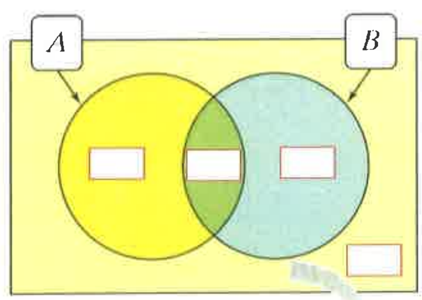

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Region in Venn diagram	In words	In symbols	Count	Probability
In the intersection of two circles	Male and pierced ears			
Inside circle *A*, outside circle *B*	Male and no pierced ears			
Inside circle *B*, outside circle *A*	Female and pierced ears			
Outside both circles	Female and no pierced ears			