AP Statistics – Chapter 5 - Day 2 Activity (updated 2024)	Name:
Goal: Understanding basic probability rules.	Date:

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

- To understand this, here is a simulation and then define the theoretical probability.
- As we proceed through this activity, you will be introduced to basic probability rules and I have provided space for you to take notes.

Step 1: Simulation
Roll 2 dice and add then. Repeat 25 times. Here are the class results

ESTIMATED Prob's

2	2%
3	5%
4	8%
5	10%
6	15%
7	17%
8	13%
9	12%
10	10%
11	5%
12	3%
TOTAL	100%

Step 2: Defining a Probability Model

List all the possible outcomes to get each sum. Use (dice1, dice2).

S

Outcomes	Sum of 2 Die (X)		Probability (P(x))
(1,1)	2	1/36	0.03
(1,2) (2,1)	3	2/36	0.06
(1,3) (2,2) (3,1)	4	3/36	0.08
(1,4) (2,3) (3,2) (4,1)	5	4/36	0.11
(1,5) (2,4) (3,3) (4,2) (5,1)	6	5/36	0.14
(1,6) (2,5) (3,4) (4,3) (5,2) (6,1)	7	6/36	0.16
(2,6) (3,5) (4,4) (5,3) (6,1)	8	5/36	0.14
(3,6) (4,5) (5,4) (6,3)	9	4/36	0.11
(4,6) (5,5) (6,4)	10	3/36	0.08
(5,6) (6,5)	11	2/36	0.06
(6,6)	12	1/36	0.03
#possible outcomes= 36		Σ= 36/36	Σ= 1.00

Theoretical probability

DEFINITIONS:

- **Sample Space (S):** The set of all possible outcomes of a chance process. **What is it here:** The list of all combitions of rolling 2 dice (circle and label)
- **Probability Model:** A description of some chance process that consists of two parts: a sample space S and a probability for each outcome. **What is it here:**

  1) X is the list of all outcomes **[label the column "X"]**

  2) p(x) is the probability of each outcome **[label the column "P(X)"]**

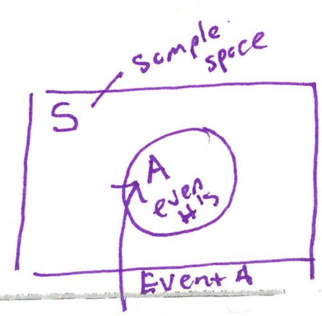
X	P(x)
2	0.03
3	0.06
⋮	⋮
12	0.03
Total	1.00

- **Event**

  1) An event is any collection of outcomes from some chance process.

  2) An event is a subset of the sample space.

  3) Events are designated by capital letters, like A, B, C, and so on



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

1) The probability of rolling a 5 is $P(5) = 0.11$

2) $P(6) =$ 0.14 *A probability must be between* 0 *and* 1.

3) The probability of NOT rolling a ~~7~~ 6 is $P(6^c) = 1 - 0.14 = \boxed{0.86}$

4) $P(8^c) = 1 - 0.14 = \boxed{0.86}$ *This is the* Complement *rule.*

5) $P(9) =$ 0.11 $P(9^c) = 1 - 0.11 = \boxed{0.89}$

AND "overlap"

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

- $P(4 \text{ and } 5) =$ 0 $P(4 \cap 5) =$ 0 $\cap$ means Intersection (and)
- *These events are* Mutually exclusive*; These are also called* DISJOINT *events.*

OR "combine"

7) The probability of rolling a 2 or a 3 $P(2 \text{ or } 3) = P(2) + P(3) = \boxed{0.09}$

8) $P(4 \text{ or } 5) = P(4) + P(5) = \boxed{0.19}$ *This is the* ADDITION RULE *rule.* FOR MUTUALLY EXCLUSIVE Events

9) $P(6 \cup 7 \cup 8) = P(6) + P(7) + P(8) = \boxed{0.44}$ U means Union (or)

Basic Probability Rules (p301, p302, p304)

1) For any Event A: $0 \le P(A) \le 1$

2) If S is the sample space: **P(S)=1**

3) Union of 2 events: **$P(A \text{ or } B) = P(A \cup B)$**

4) Intersection of 2 events: **$P(A \text{ and } B) = P(A \cap B)$**

5) Complement Rule: **$P(A^C) = 1 - P(A)$**

6) Mutually Exclusive (disjoint) **Two events are mutually exclusive (disjoint) if they have no outcomes in common and so can never occur together.**

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

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

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

Let:

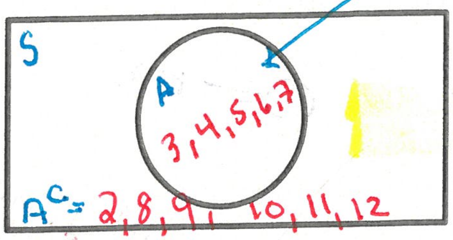
- Event A: rolling 2 dice with sums 3-7
- Event B: rolling 2 dice with sums 7-10

Draw Venn diagrams to find these probabilities:

Event A

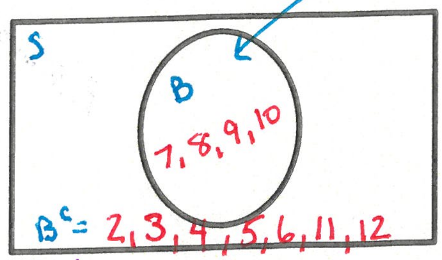
Event B

P(A)= 0.55



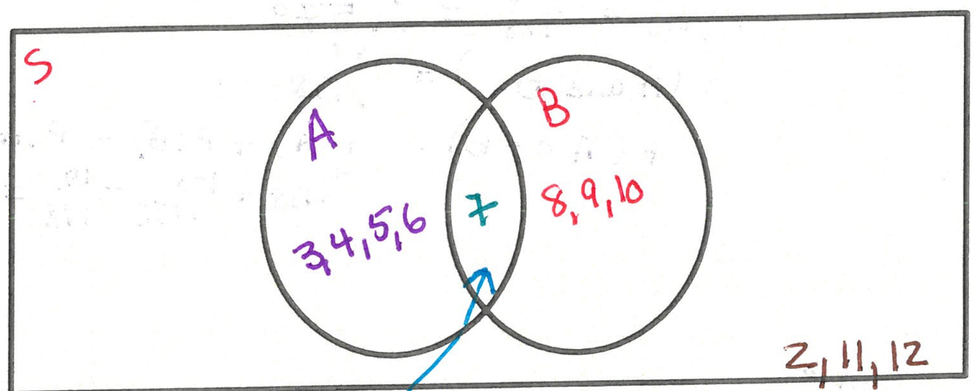
P(A^C)= 1 − P(A) = 0.45

P(B)= 0.49



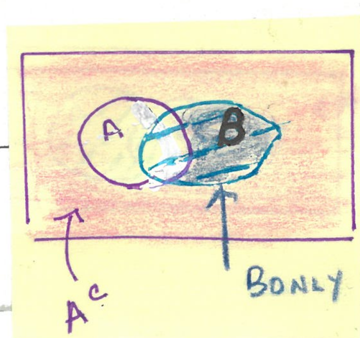
P(B^C)= 1 − P(B) = 0.51

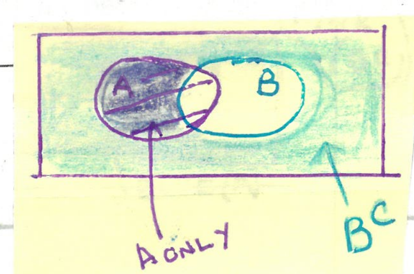
Draw the Venn Diagram to combine Events A and B and then answer these questions. Fill in the probability syntax:



1. P(A and B)= P(A ∩ B)= P(7) = 0.16 [INTERSECT]
2. P(A or B)= P(A ∪ B)= P(A) + P(B) − P(A and B) [UNION]
   0.55 + 0.49 − 0.16 = 0.88
3. P(ONLY A)= P(A and B^c)= P(3) + P(4) + P(5) + P(6) = $\boxed{0.39}$
   P(A) − P(A and B)
4. P(ONLY B)= P(A^c and B)= P(8) + P(9) + P(10) = $\boxed{0.33}$

A ONLY

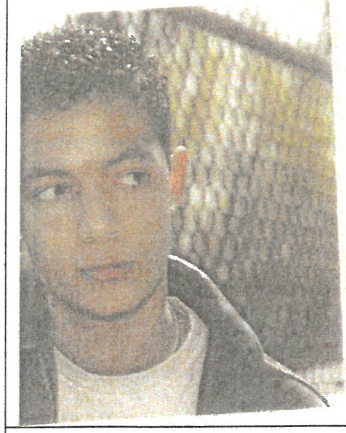




EXAMPLE

Who Has Pierced Ears?

Two-way tables and probability



Students in a college statistics class wanted to find out how common it is for young adults to have their ears pierced. They recorded data on two variables—gender and whether the student had a pierced ear—for all 178 people in the class. The two-way table below displays the data.

Let:
A=Males
B=Pierced Ears

P(A and B)

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

P(A)

P(B)

GOTO Venn diagram

Suppose we choose a student at random. Find the probability that the student (use correct probability notation, give as a fraction, and decimal)

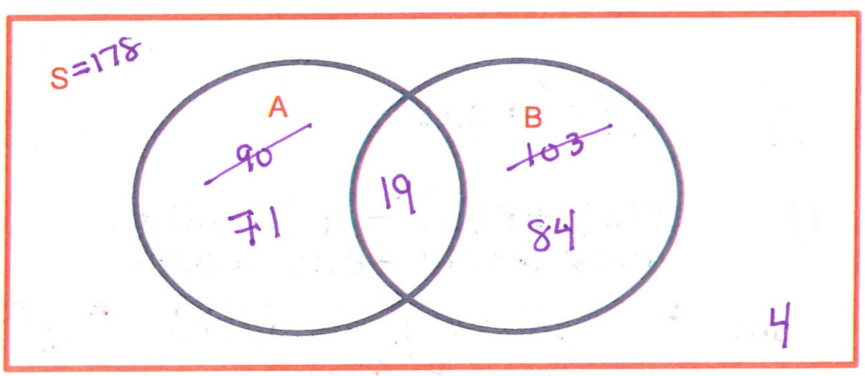
a) Has pierced ears. $P(B) = \frac{103}{178} = 0.579$

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

c) Is male or has pierced ears. $P(A \text{ or } B) = P(A) + P(B) - P(A \text{ and } B)$

$90/178 + 103/178 - \frac{19}{178} = \frac{174}{178} = 0.978$

Fill in the Venn Diagram to combine Events A and B and then answer these questions. (use correct probability notation and give as a fraction ONLY)



- P(male and pierced ears)= P(A and B)= $19/178 = 0.107$
- P(female and pierced ears)= P(A^c and B)= $84/178 = 0.472$
- P(female and no pierced ears)= P(A^c and B^c)= $4/178 = 0.022$

ASK YOUR SELF: DO YOU FIND PROBALITY USING A TABLE OR VENN DIAGRM?