Subjective Probability

- What is subjective probability? You can't always repeat an experiment a large # of times. We estimate probability on subjective judgement, experience, information or belief
- Give an example where you would use subjective probability?

Who will win this year's NA/FC Basketball game
Based on previous years --- NA will win.

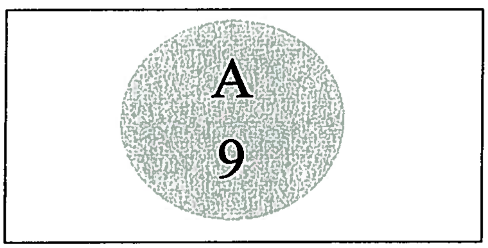
ASSIGNMENT EXERCISES 3A

Pg. 67-68 # 1-7

Section 3.2

Venn Diagrams

There are 30 students in the IB Math SL classes. 9 of them have Mr. Kaiser. Show this information in a Venn Diagram



Set A is students who have Mr. Kaiser.

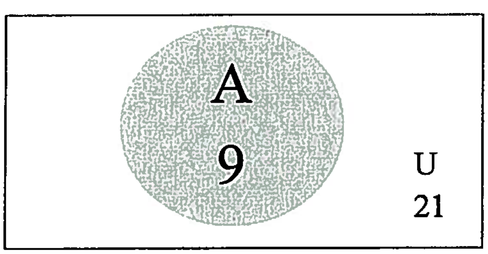
$n(A)=9$

The rectangle represent the 30 students.
$n(U)=30$

If an IB Math SL student is chosen at random. The probability they have Mr. Kaiser, $P(A)=\frac{9}{30}=\frac{3}{10}$

Complementary event A'

- A' (read A prime) is the complement of set A
- The complement represents the number of times the event does not occur.



From the diagram we see that $n(A')=n(U)-n(A)$
$30-9=21$

The probability that a student does not have Mr. Kaiser,

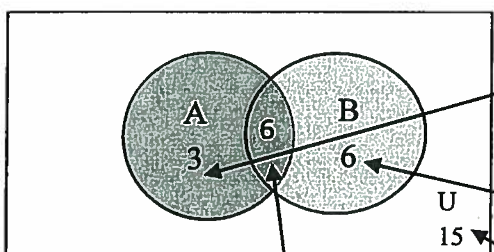
$P(A')=\frac{21}{30}=\frac{7}{10}$

- As an event, A, either happens or it does not happen:
  1. $P(A) + P(A') = 1$
  2. $P(A') = 1 - P(A)$

Intersection and Union of Events

Symbols	Meaning
$P(A)$	Probability of A
$P(A')$	Probability of not A
$P(A \cap B)$ → Intersection	Probability of A AND B
$P(A \cup B)$ → Union	Probability of A OR B

Of the 30 students in IB Math SL 12 of them have Mr. Mumaw for chemistry. Of those, 6 have both Mr. Kaiser and Mr. Mumaw.



- (Event A) 9 Student have Mr. Kaiser. 6 students have Mr. Kaiser And Mr. Mumaw, so $9-6=3$ have just Mr. Kaiser.
- (Event B) 12 students have Mr. Mumaw. 6 students have Mr. Mumaw and Mr. Kaiser, so $12-6=6$
- The overlapping region is the intersection of A and B. This represents students who have both Mr. Kaiser and Mr Mumaw. The region is written $A \cap B$.
- There are $30-3-6-6=15$ students that do not have Mr. Kaiser or Mr. Mumaw.

Find the probability that a student chosen at random has both Mr. Kaiser and Mr. Mumaw.

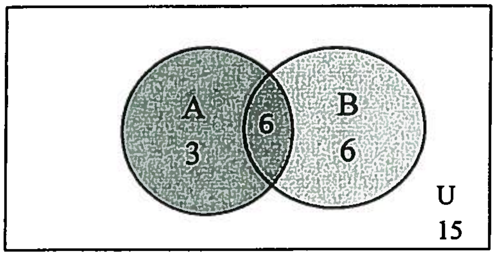
$$P(A \cap B) = \frac{6}{30} = \frac{1}{5}$$

Find the probability that a student chosen at random has Mr. Kaiser but not Mr. Mumaw.

$$P(A \cap B') = \frac{3}{30} = \frac{1}{10}$$

What does $A' \cap B'$ represent?

Not Kaiser and Not Mumaw



- The entire shaded region is the **union** of A and B. The region represents those students that have either Mr. Kaiser, Mr. Mumaw, or both.
- The region is written $A \cup B$.
- Notice that "or" in mathematics includes the possibility of both – we call it the "inclusive" or.

Find the probability that a student chosen at random has either Mr. Kaiser or Mr. Mumaw.

$P(A \cup B)$ $\quad n(A \cup B) = 3+6+6 = 15$

$$P(A \cup B) = \frac{n(A \cup B)}{n(U)} = \frac{15}{30} = \frac{1}{2}$$

How would you represent the probability of students that have Mr. Kaiser or do not have Mr. Mumaw? Then find that probability. $P(A \cup B')$

$n(A \cup B') = 3+6+15 = 24$ $\quad P(A \cup B') = \frac{n(A \cup B')}{n(U)} = \frac{24}{30} = \frac{4}{5}$

Example. In a group of 40 student, 12 play basketball, 15 play baseball, and 19 play neither.
- Draw a Venn diagram to show this information.
- Use the Venn diagram to find the probability that
  a. A student chosen at random from the group plays basketball.
  b. A student plays both basketball and baseball.
  c. A student plays baseball but not basketball.
  d. A student plays baseball or basketball.

Let x play both
H = basketball
B = baseball

$x + (12-x) + (15-x) + 19 = 40$
$x - 2x + 46 = 40$
$-x = -6$
$x = 6$

or H + B + neither
$12+15+19 = 46$
-40 total
6

a) $P(H) = \frac{12}{40} = 3/10$

b) $P(H \cap B) = \frac{6}{40} = 3/20$

c) $P(H' \cap B) = \frac{9}{40}$

d) $P(H \cup B) = \frac{6+6+9}{40} = \frac{21}{40}$

ASSIGNMENT EXERCISES 3B

Pg. 71-72
1-6

Addition Rule

The probability that a student has Mr. Kaiser and the probability that a student has Mr. Mumaw each includes the probability that a student has both Mr. Kaiser and Mr. Mumaw.

We only wish to include the probability once so we subtract one of these probabilities.

> For any two events A and B
>
> $P(A\cup B) = P(A) + P(B) - P(A\cap B)$
>
> A OR B — A AND B

Kaiser or mumaw — Kaiser and mumaw

Example: A card is drawn at random from an ordinary pack of 52 playing cards. Find the probability that the card is red or an ace.

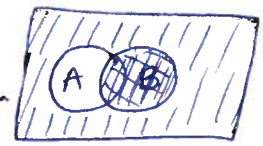
$P(R\cup A) = P(R) + P(A) - P(R\cap A) = \frac{26}{52} + \frac{4}{52} - \frac{2}{52} = \frac{28}{52} = \frac{7}{13}$

$n(R) = 26$

$n(A) = 4$

$n(R\cap A) = 2$

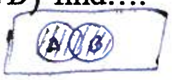
Example: If A and B are two events such that $P(A) = \frac{4}{5}$ and $P(B) = \frac{3}{8}$ and



$P(A\cup B) = 3P(A\cap B)$ find....

Let $P(A\cap B) = x$

a. $P(A\cup B)$



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

$3x = 4/5 + 3/8 - x$

$4x = \frac{32}{40} + \frac{15}{40}$

$4x = \frac{47}{40}$

$x = \frac{47}{160} = P(A\cap B)$

$P(A\cup B) = 3P(A\cap B)$

$= 3(47/160)$

$= \boxed{141/160}$

b. $P(A\cup B)'$

$P(A\cup B)' = 1 - P(A\cup B)$

$= 1 - \frac{141}{160}$

$= \frac{19}{160}$

c. $P(A'\cup B)$

$P(A'\cup B) = P(B) + P(A\cup B)'$

$\frac{3}{8} + \frac{19}{160} = \frac{60}{160} + \frac{19}{160}$

$\boxed{\frac{79}{160}}$

or

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

$\frac{1}{5} + \frac{47}{160}$

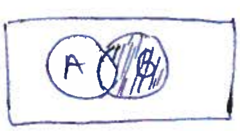
$\frac{32}{160} + \frac{47}{160} = \frac{79}{160}$

d. $P(A'\cap B)$

$P(A'\cap B) = P(B) - P(A\cap B)$

$3/8 - \frac{47}{160}$

$\frac{60}{160} - \frac{47}{160} = \boxed{\frac{13}{160}}$



ASSIGNMENT EXERCISES 3C

Pg. 74-75

#1-8

Mutually Exclusive Events

What are mutually exclusive events? $P(A \cap B) = 0$

events that cannot happen at the same time

Give an example.

Turning left and turning right

Tossing a coin

> In general if A and B are mutually exclusive, then $P(A \cap B) =$ 0 and
>
> $P(A \cup B) = P(A) + P(B)$

Example: A bag of Jolly Ranchers has various flavors. You pull a piece of candy out at random. The probability of pulling a cherry candy is $\frac{5}{8}$, and the probability of a grape candy is $\frac{2}{9}$. Are picking a cherry or grape candy mutually exclusive? Why? What is the probability of drawing neither a cherry or grape candy?

mutually exclusive: yes – you can't pull two different flavors

$$P(C \cup G) = \frac{5}{8} + \frac{2}{9} = \frac{45}{72} + \frac{16}{72} = \frac{61}{72}$$

$$P(C \cup G)' = 1 - \frac{61}{72} = \frac{11}{72}$$

ASSIGNMENT EXERCISES 3D Pg. 76-77 #1-4

Section 3.3

Sample Space Diagrams

List the sample space for rolling two six sided die.

	1	2	3	4	5	6
1	1,1	1,2	1,3	1,4	1,5	1,6
2	2,1	2,2	2,3	2,4	2,5	2,6
3	3,1	3,2	3,3	3,4	3,5	3,6
4	4,1	4,2	4,3	4,4	4,5	4,6
5	5,1	5,2	5,3	5,4	5,5	5,6
6	6,1	6,2	6,3	6,4	6,5	6,6

ASSIGNMENT EXERCISES 3E

Pg. 79 #1-5