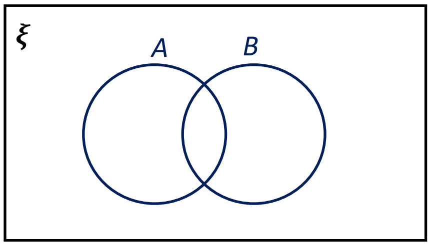
Venn diagrams and sample space

Venn diagrams

A **Venn diagram** consists of a rectangle containing one or more circular areas.



The rectangle represents the **universal set** (ξ).

The universe set is not "everything in existence", but "everything that we're working with right now". The universal set represents every element for a particular situation being examined.

The circles represent particular **outcomes or groups** of the sample space

A represents **Group A**

B represents **Group B**

Example 1

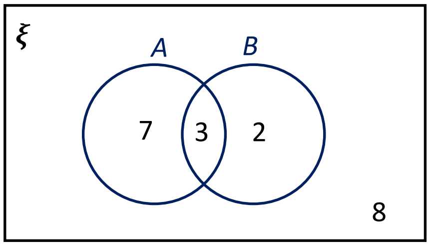
In a class of 20 students, 10 study Art, 5 study Biology and 3 study both.

Construct a Venn diagram, where;

ξ = {students in the class}

A = {student who study Art}

B = {students who study Biology}



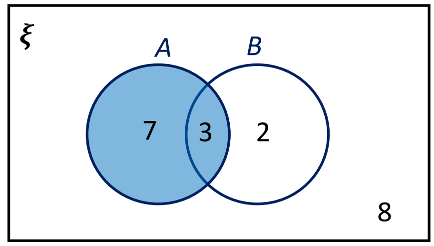
If 1 student were selected from the class what would be the probability that the student is:

i. An Art student
ii. A Biology student
iii. An Art student but not a Biology student
iv. A Biology student but not an Art student
v. Neither an Art or Biology student
vi. Both an Art and Biology student

i. An Art student

$n(A) = 10$

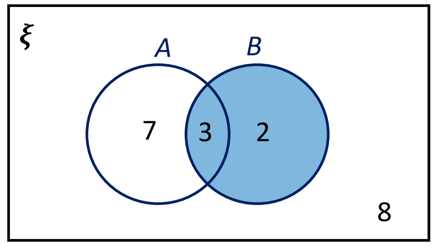
$$\Pr(A) = \frac{n(A)}{n(\xi)} = \frac{10}{20} = \frac{1}{2}$$



ii. A Biology student

$n(B) = 5$

$$\Pr(B) = \frac{n(B)}{n(\xi)} = \frac{5}{20} = \frac{1}{4}$$

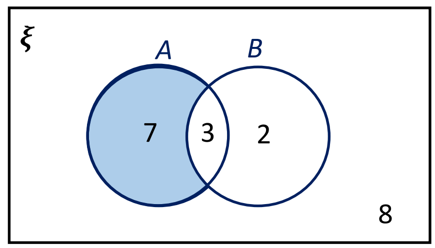


iii. An Art student but not a Biology student

$n(A\ \boldsymbol{and\ not}\ B) = 7$

$n(A\ \cap\ B') = 7$

$$\Pr(A \cap B') = \frac{n(A \cap B')}{n(\xi)} = \frac{7}{20}$$

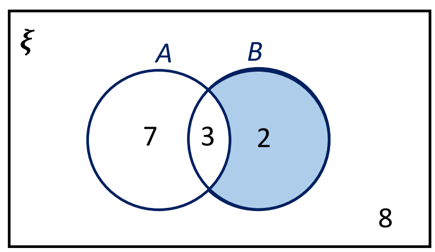


iv. A Biology student but not an Art student

$n(B\ \boldsymbol{and\ not}\ A) = 2$

$n(B\ \cap\ A') = 2$

$$\Pr(B \cap A') = \frac{n(A \cap B')}{n(\xi)} = \frac{2}{20} = \frac{1}{10}$$

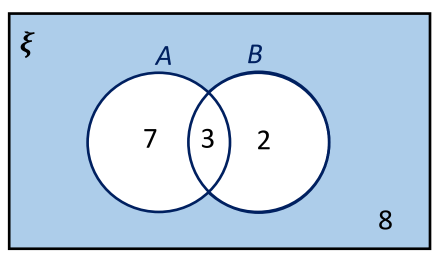


v. Neither an Art or Biology student

$n(\boldsymbol{not}\ A\ \boldsymbol{and\ not}\ B) = 8$

$n(A'\ \cap\ B') = 8$

$$\Pr(B \cap A') = \frac{n(A \cap B')}{n(\xi)} = \frac{8}{20} = \frac{2}{5}$$

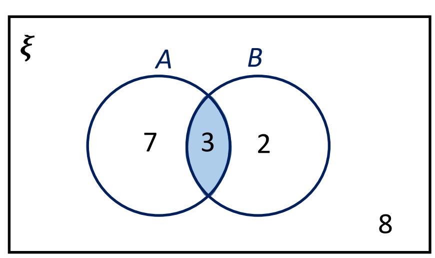


vi. Both an Art and Biology student

$n(A\ \boldsymbol{and}\ B) = 3$

$n(A\ \cap\ B) = 3$

$$\Pr(A \cap B) = \frac{n(A \cap B)}{n(\xi)} = \frac{3}{20}$$



Tables

In a similar way, a **table** can be used to show similar information. Consider the following **two –way table.**

	$\boldsymbol{B}$	$\boldsymbol{not\ B\ (B')}$
$\boldsymbol{A}$	$A\ and\ B\ (A \cap B)$	$A\ and\ not\ B\ (A \cap B')$
$\boldsymbol{not\ A\ (A')}$	$not\ A\ and\ B\ (A' \cap B)$	$not\ A\ and\ not\ B\ (A' \cap B')$

Example 2

In a class of 20 students, 10 study Art, 5 study Biology and 3 study both.
Construct a two-way table.

The number of each group is as follows:

	$\boldsymbol{Biology\ (B)}$	$\boldsymbol{not\ Biology\ (B')}$	**Total**
$\boldsymbol{Art\ (A)}$	3	7	**10**
$\boldsymbol{not\ Art\ (A')}$	2	8	**10**
Total	**5**	**15**	**20**

The probability of each group is as follows:

	$\boldsymbol{Biology\ (B)}$	$\boldsymbol{not\ Biology\ (B')}$
$\boldsymbol{Art\ (A)}$	3/20	7/20
$\boldsymbol{not\ Art\ (A')}$	2/20	8/20