



Probability tables

Year 11
Mathematical Methods

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Learning Objectives

By the end of the lesson, I hope that you understand and can apply the following to a range of questions from the Year 11 Mathematical Methods course.

- Understand that we can express a Venn Diagram as a Probability table (also known as a Karnaugh Map).
- Know how to construct and read a probability table to find various probabilities
- Know how to use the theory to answer a range of problems



RECAP

In the last lesson we looked at how we can use Venn Diagrams to represent and answer a range of probability problems. We also met the addition rule and understood why we needed to subtract $\Pr(A \cap B)$.

We are going to continue with the same form of theory but introduce another (perhaps better) way to represent probabilities.

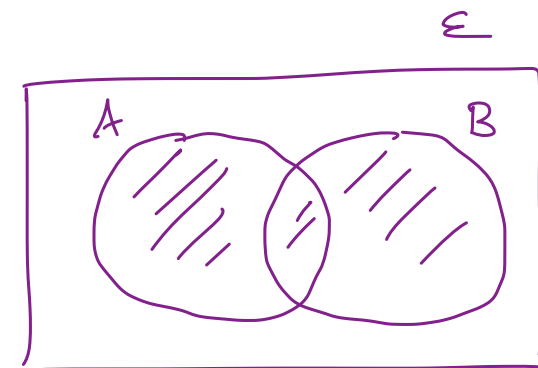
$$A = \{1, 2, 3, 4, 5, 6\}$$

$$B = \{3, 4, 7, 8\}$$

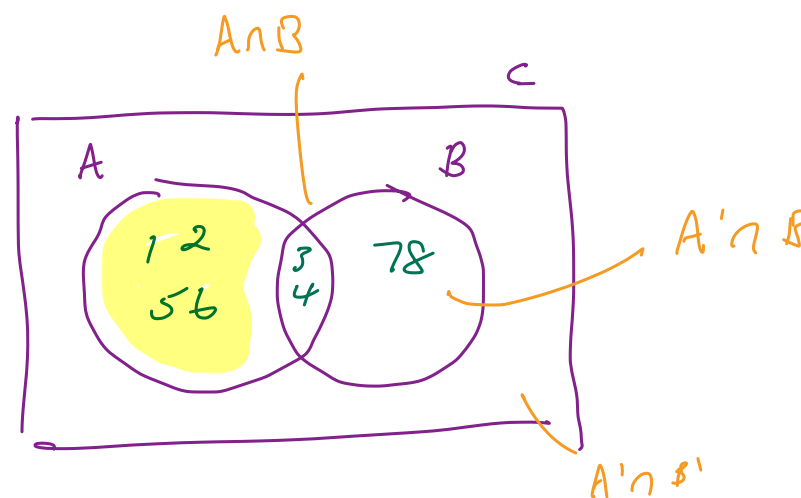
$$B' = \{1, 2, 5, 6\}$$

$$A' = \{7, 8\}$$

$$A \cap B'$$

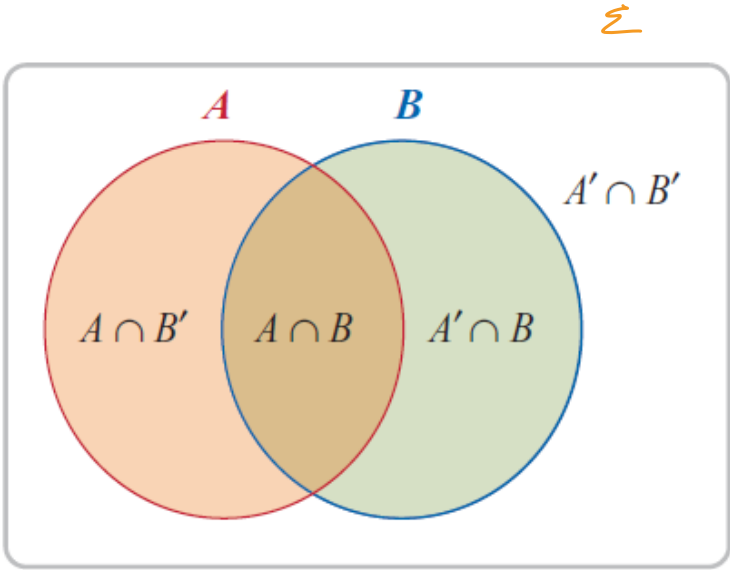


$$E = \{1, 2, 3, 4, 5, 6, 7, 8\}$$



Venn Diagram in a different way

In looking at the Venn Diagram below, we can see that it can be split into 4 distinct sections. Each of these pretty much uses the idea of combining $\Pr(A)$, $\Pr(\bar{A})$, $\Pr(B)$ and $\Pr(\bar{B})$. We can represent this in a different way using something called a Karnaugh Map or Probability table.



	B	B'
A	$A \cap B$	$A \cap B'$
A'	$A' \cap B$	$A' \cap B'$



A more useful version of the Karnaugh Map

The bottom row and right-hand column are so very important to the understanding and, in my view, make answering questions so much easier than a Venn Diagram!

	B	B'	
A	$\Pr(A \cap B)$	$\Pr(A \cap B')$	$\Pr(A)$
A'	$\Pr(A' \cap B)$	$\Pr(A' \cap B')$	$\Pr(A')$
	$\Pr(B)$	$\Pr(B')$	1

More often than not, a question will give you one piece of information for the “inside” of the table and two pieces which make up the bottom row or last column.



Example 1

If A and B are events such that $\Pr(A) = 0.7$, $\Pr(A \cap B) = 0.4$ and $\Pr(A' \cap B) = 0.2$, find:

a $\Pr(A \cap B')$

b $\Pr(B)$

c $\Pr(A' \cap B')$

d $\Pr(A \cup B)$



$\cap$	B	B'	
A	0.4	0.3	0.7
A'	0.2	0.1	0.3
	0.6	0.4	1

a. $\Pr(A \cap B') = 0.3$

b. $\Pr(B) = 0.6$

c. $\Pr(A' \cap B') = 0.1$

d. $\Pr(A \cup B) = 0.9$

↙

	B	B'	
A	$\Pr(A \cap B)$	$\Pr(A \cap B')$	$\Pr(A)$
A'	$\Pr(A' \cap B)$	$\Pr(A' \cap B')$	$\Pr(A')$
	$\Pr(B)$	$\Pr(B')$	1



Example 2

Records indicate that, in Australia, 65% of secondary students participate in sport, and 71% of secondary students are Australian by birth. They also show that 53% of students are Australian by birth and participate in sport. Use this information to find:

- the probability that a student selected at random is not Australian by birth
- the probability that a student selected at random is not Australian by birth and does not participate in sport.

	A	$\bar{A}$	
S	0.53	0.12	0.65
$\bar{S}$	0.18	0.17	0.35
	0.71	0.29	1

	B	B'	
A	$\Pr(A \cap B)$	$\Pr(A \cap B')$	$\Pr(A)$
A'	$\Pr(A' \cap B)$	$\Pr(A' \cap B')$	$\Pr(A')$
	$\Pr(B)$	$\Pr(B')$	1

$$P(S)$$

$$P(\bar{S})$$

$$P(A)$$

$$P(\bar{A})$$

$$a. \Pr(\bar{A}) = 0.29$$

$$b. \Pr(\bar{A} \cap \bar{S}) = 0.17$$



Learning Objectives: Reviewed

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