

### 3.13 Things you should know

What does  $P(A)$  mean?

Prob A occurring

What does  $P(A')$  mean?

Prob not A occurring

What does  $P(A \cap B)$  mean?

Prob of A and B

What does  $P(A \cup B)$  mean?

Probability of A or B

What does  $P(A/B)$  mean?

Prob of A given B  
has happened

$$P(A/B) = \frac{P(A \cap B)}{P(B)}$$

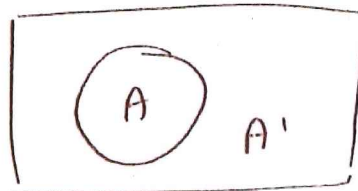
What does  $P(A/B')$  mean?

Prob A given B  
doesn't happen

$$P(A/B') = \frac{P(A \cap B')}{P(B')}$$

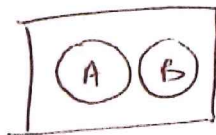
What is a complementary event?

Can't both occur  
If one does the  
other does not.



What is a mutually exclusive event?

Can't both  
occur, but  
can both not  
occur



How do we prove mutually exclusiveness?

$$P(A \cap B) = 0$$

and

$$P(A) + P(B) = 1$$

What are independent events?

Don't effect one  
another

How do we prove independence?

If  $P(A \cap B) = P(A) \times P(B)$   
then two events are  
independent.

What is the definition of:

a) true probability

Actually probability of an event happening  
Usually unknown.

b) experimental probability

Using past results to calculate a probability

c) theoretical probability

Using a model ie getting a six on a dice  
=  $\frac{1}{6}$

What is a combination and when do we use it?

Order is not important  
eg  ${}^{13}C_8$

What is a permutation and when do we use it?

Order does matter  
eg  ${}^8P_3$

What is a factorial?

eg.  $5! = 5 \times 4 \times 3 \times 2 \times 1$

How many ways can you eat 5 easter eggs

What is risk?

eg is the likelihood of you getting a disease  
ie lung cancer  
0.11 or 11% or  $\frac{1}{9}$

How do you calculate risk?

What is relative risk?

Risk compared between two groups

How do you calculate relative risk?

$$\frac{\text{Smoker \& cancer}}{\text{non-sm \& cancer}} = \frac{0.25}{0.02} = 12.5$$

$\therefore$  smokers are 12.5 times more likely to get cancer.

# Exercises on Probability Tables

1.  $P(A) = 0.3, P(B) = 0.4, P(A \cap B) = 0.2$

	A	A'	
B	0.2	0.2	0.4
B'	0.1	0.5	0.6
	0.3	0.7	1

Complete the table and answer the following questions.

- (a) What is the probability that A or B occurs?  $P(A \cup B) = 0.5$
- (b) What is the probability that neither A nor B occurs?  $P(A \cup B)' = 0.5$
- (c) Are A and B independent?  $P(B) \times P(A) = 0.3 \times 0.4 = 0.12 \neq 0.2$  Not independent as not equal
- (d) Find  $P(A|B) = \frac{P(A \cap B)}{P(B)} = \frac{0.2}{0.4} = 0.5$
- (e) Are A and B mutually exclusive?  
No as  $P(A \cap B) = 0.2$  not 0

2.  $P(A)$  is 0.5,  $P(B)$  is 0.3, and A and B are independent events.

	A	A'	
B	0.15	0.15	0.3
B'	0.35	0.35	0.7
	0.5	0.5	1

→ as  $P(A) \times P(B)$

Complete the table and answer the following questions.

- (a) What is the probability that A or B occurs?  $P(A \cup B) = 0.65$
- (b) What is  $P(B|A')$ ?  $= \frac{P(B \cap A')}{P(A')} = \frac{0.15}{0.5} = 0.3$
- (c) Are A and B mutually exclusive?  
No as  $P(A \cap B) = 0.15 \therefore$  Both can happen

3.  $P(A)$  is 0.4,  $P(A \cap B) = 0.2$ , and A and B are independent events.

	A	A'	
B	0.2	0.3	0.5
B'	0.2	0.3	0.5
	0.4	0.6	1

Complete the table and answer the following questions.

- (a) What is the probability that A or B occurs?  $P(A \cup B) = 0.7$
- (b) What is the probability that neither A nor B occurs? 0.3
- (c) What is  $P(A|B)$ ?  $= \frac{P(A \cap B)}{P(B)} = \frac{0.2}{0.5} = 0.4$

4.  $P(A) = 0.2$ ,  $P(B) = 0.7$ ,  $P(A \cup B) = 0.85$

	A	A'	
B	0.05	0.65	0.7
B'	0.15	0.15	0.3
	0.2	0.8	1

Complete the table and answer the following questions.

- (a) Are A and B mutually exclusive? No as  $P(A \cap B) = 0.05$
- (b) What is the probability that neither A nor B occurs? 0.15
- (c) What is  $P(A|B)$ ?

$$\frac{P(A \cap B)}{P(B)} = \frac{0.05}{0.7} = 0.0714 \text{ (4dp)}$$

5.  $P(A \cup B) = 0.9, P(A) = 0.3, P(B) = 0.6$

	A	A'	
B	0	0.6	0.6
B'	0.3	0.1	0.4
	0.3	0.7	1

Complete the table and answer the following questions.

- (a) What is the probability that both of A and B occur? 0
- (b) What is the probability that neither A nor B occurs? 0.1
- (c) Are A and B mutually exclusive? Yes as  $P(A \cap B) = 0$
- (d) Are A and B independent events?  $0.3 \times 0.6 = 0.18 \neq 0$  so no not independent

6.  $P(A) = 0.35, P(B) = 0.4, P(A|B) = 0.5$        $0.5 = \frac{P(A \cap B)}{0.4}$

	A	A'	
B	0.2	0.2	0.4
B'	0.15	0.45	0.6
	0.35	0.65	1

Complete the table and answer the following questions.

- (a) What is the probability that A or B occurs? 0.55
- (b) What is the probability that neither A nor B occurs? 0.45
- (c) What is  $P(B|A')$ ?  $\frac{P(B \cap A')}{P(A')} = \frac{0.2}{0.65} = 0.3077$  (4dp)
- (d) Are A and B independent?

$$P(A) \times P(B) = 0.35 \times 0.4 = 0.14$$

$$P(A \cap B) = 0.2$$

$0.2 \neq 0.14 \therefore$  not equal, not independent.