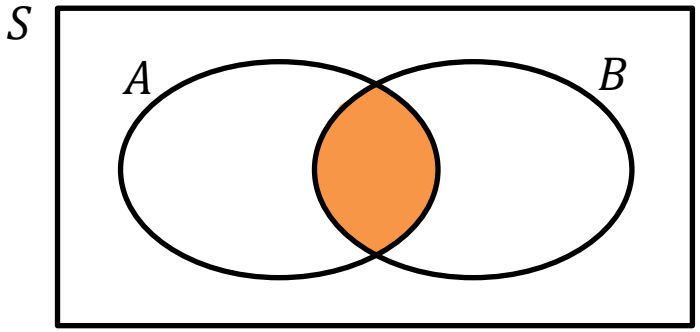
Stats1 Chapter 5: Probability

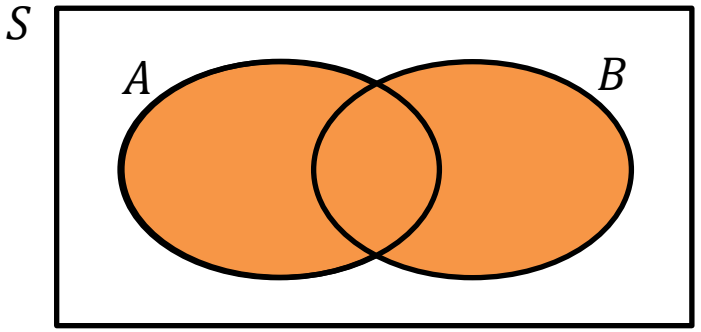
Venn Diagrams

Venn Diagrams

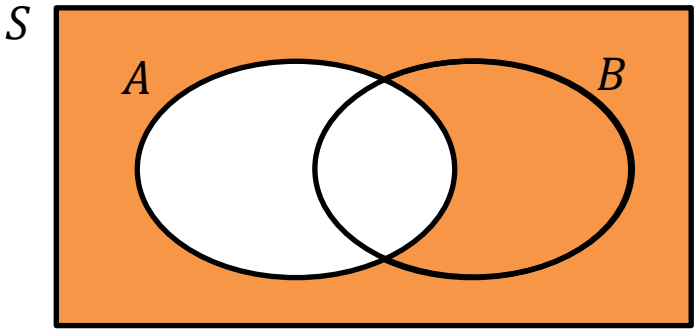
Venn Diagrams allow us to combine events, e.g. "A happened **and** B happened".



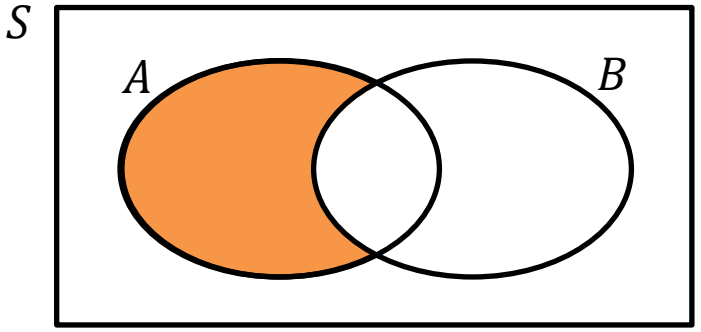
The event "A **and** B"
Known as the **intersection** of A and B.



The event "A **or** B"
Known as the **union** of A and B.



The event "not A"
Known as the **union** of A and B.



These can be combined,
e.g. "A and not B".

Example involving probabilities

We can either put frequencies or probabilities into the Venn Diagram.

Given that $P(A) = 0.6$ and $P(A \text{ or } B) = 0.85$, find the probability of:

a) $P(\text{not } A \text{ and } B)$

b) $P(\text{neither } A \text{ nor } B)$

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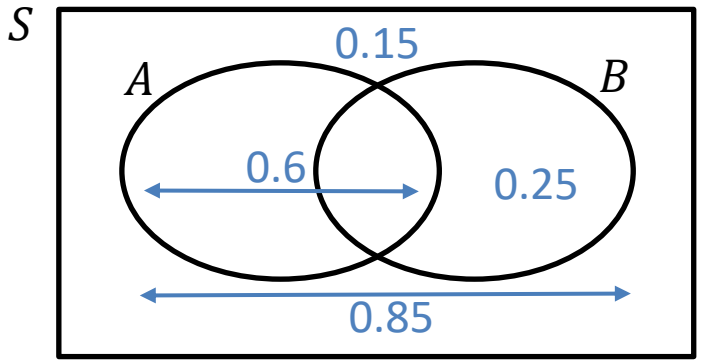


$P(\text{not } A \text{ and } B) = \mathbf{0.85 - 0.6 = 0.25}$

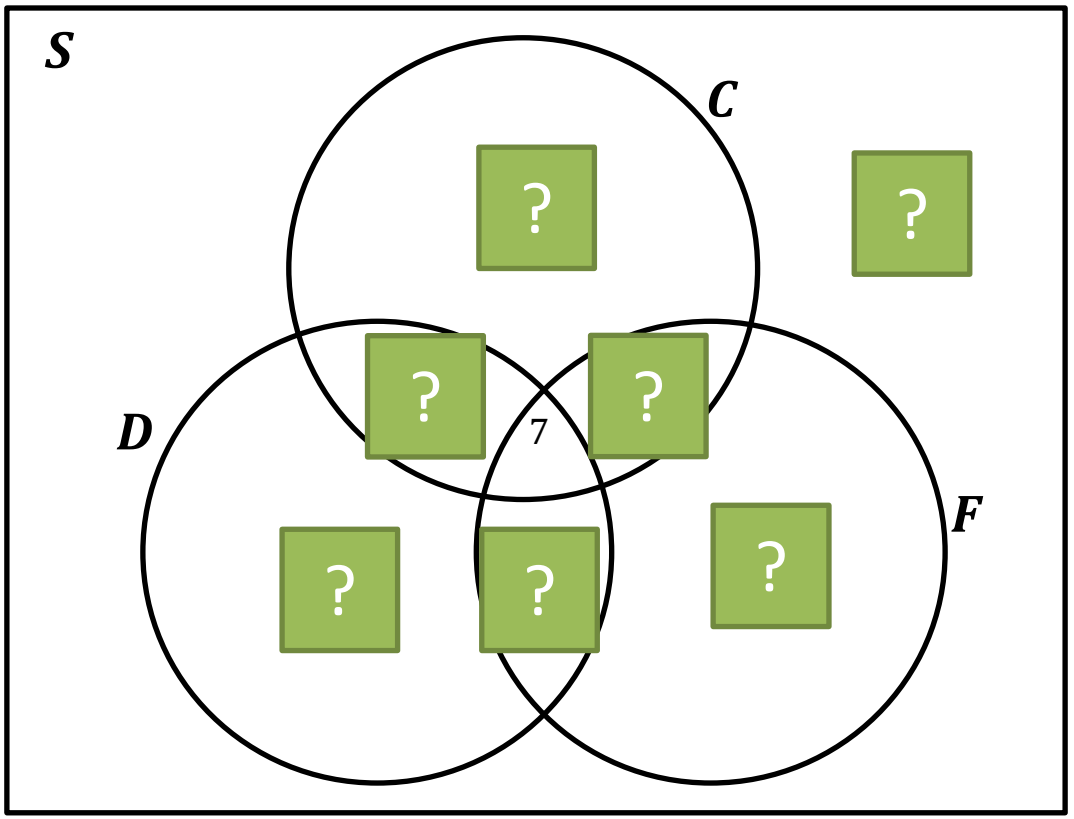
$P(\text{neither } A \text{ nor } B) = \mathbf{1 - 0.85 = 0.15}$

Example involving frequencies

A vet surveys 100 of her clients. She finds that
25 own dogs, 15 own dogs and cats, 11 own dogs and tropical fish, 53 own cats, 10 own cats and tropical fish, 7 own dogs, cats and tropical fish, 40 own tropical fish.

Fill in this Venn Diagram, and hence answer the following questions:

a) $P(owns\ dog\ only)$
b) $P(does\ not\ own\ tropical\ fish)$
c) $P(does\ not\ own\ dogs,\ cats, or\ tropical\ fish)$



Tip: Start from the centre frequency and work your way outwards using subtraction.

a) ?
b) ?
c) ?


Dr Frost's cat "Pippin"

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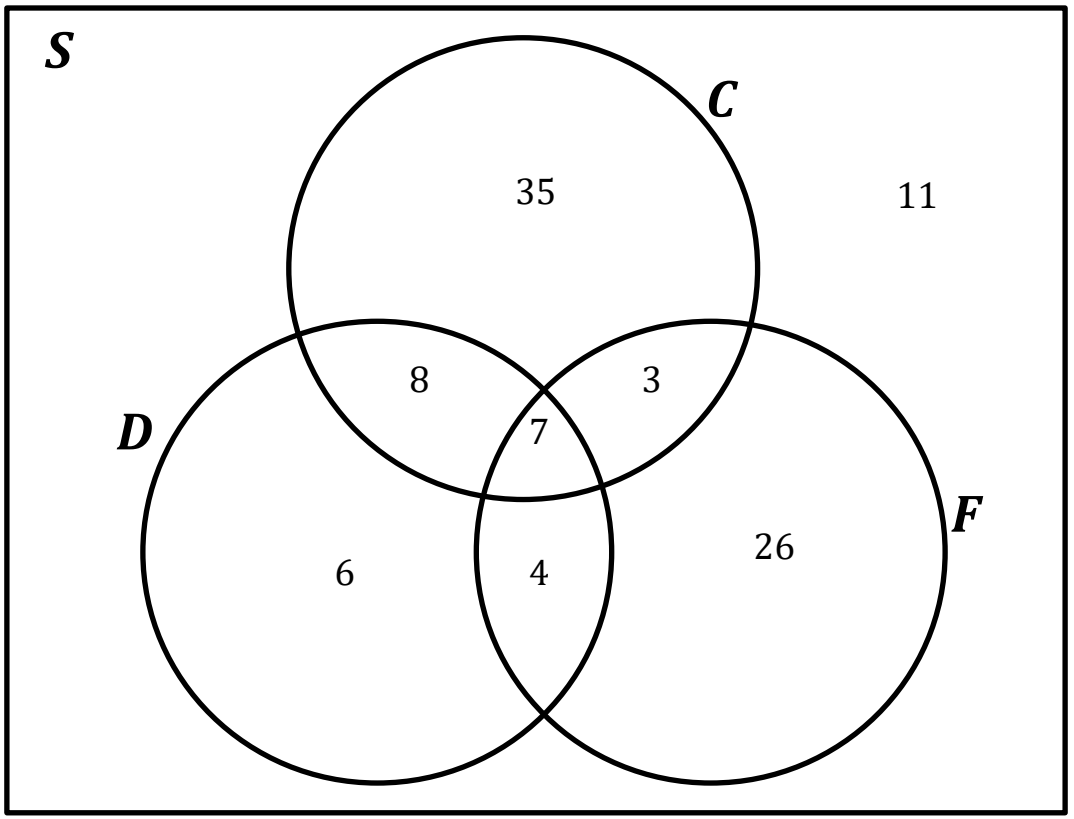


Tip: Start from the centre frequency and work your way outwards using subtraction.

a) $\frac{6}{100} = \frac{3}{50}$
b) $\frac{60}{100} = \frac{3}{5}$
c) $\frac{11}{100}$


Dr Frost's cat "Pippin"

Test Your Understanding

Jan 2012 Q6

The following shows the results of a survey on the types of exercise taken by a group of 100 people.

65 run	48 swim
60 cycle	40 run and swim
30 swim and cycle	35 run and cycle
25 do all three	

(*a*) Draw a Venn Diagram to represent these data. **(4)**

Find the probability that a randomly selected person from the survey

(*b*) takes none of these types of exercise, **(2)**

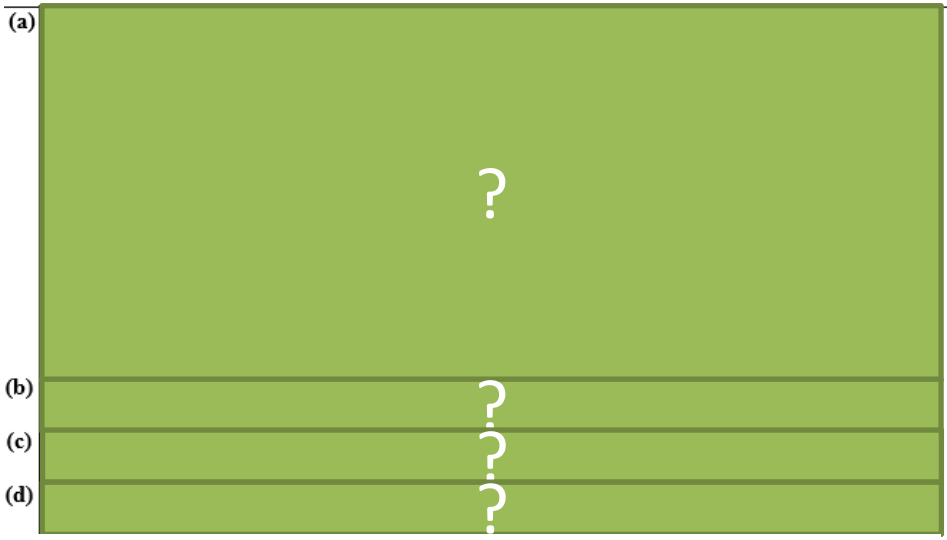
(*c*) swims but does not run, **(2)**

(d) takes at least two of these types of exercise. **(2)**

~~Jason is one of the above group. Given that Jason runs,~~

~~(*e*) find the probability that he swims but does not cycle.~~ **(3)**

Tip: You'll lose a mark if you don't have a box!



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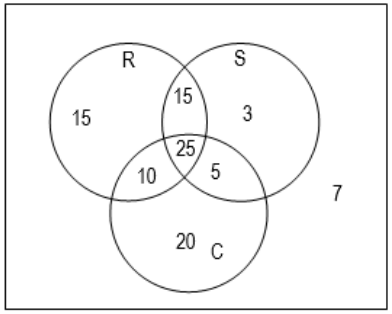
(a)



	3 closed curves and 25 in correct place	M1
	15,10,5	A1
	15,3,20	A1
	Labels *R*, *S*, *C* and box	B1

(b) All values/100 or equivalent fractions award accuracy marks.

7/100 or 0.07 — M1 for ('their 7' in diagram or here)/100 — M1 A1

(c) (3+5)/100 = 2/25 or 0.08 — M1A1

(d) (25+15+10+5)/100 = 11/20 or 0.55 — M1 A1

Exercise 5.2

Pearson Applied Year 1/AS
Pages 32-33

Homework Exercise

1 There are 25 students in a certain tutor group at Philips College. There are 16 students in the tutor group studying German, 14 studying French and 6 students studying both French and German.

a Draw a Venn diagram to represent this information.

b Find the probability that a randomly chosen student in the tutor group:

i studies French

ii studies French and German

iii studies French but not German

iv does not study French or German.

2 There are 125 diners in a restaurant who were surveyed to find out if they had ordered garlic bread, beer or cheesecake:

15 diners had ordered all three items
43 diners had ordered garlic bread
40 diners had ordered beer
44 diners had ordered cheesecake
20 had ordered beer and cheesecake
26 had ordered garlic bread and cheesecake
25 had ordered garlic bread and beer

a Draw a Venn diagram to represent this information.

A diner is chosen at random. Find the probability that the diner ordered:

b i all three items

ii beer but not cheesecake and not garlic bread

iii garlic bread and beer but not cheesecake

iv none of these items.

3 A group of 275 people at a music festival were asked if they play guitar, piano or drums:

one person plays all three instruments
65 people play guitar and piano
10 people play piano and drums
30 people play guitar and drums
15 people play piano only
20 people play guitar only
35 people play drums only

a Draw a Venn diagram to represent this information.

b A festival goer is chosen at random from the group.
Find the probability that the person chosen:

i plays the piano

ii plays at least two of guitar, piano and drums

iii plays exactly one of the instruments

iv plays none of the instruments.

Homework Exercise

4 The probability that a child in a school has blue eyes is 0.27 and the probability that they have blonde hair is 0.35. The probability that the child will have blonde hair or blue eyes or both is 0.45. A child is chosen at random from the school. Find the probability that the child has:

a blonde hair and blue eyes

b blonde hair but not blue eyes

c neither feature.

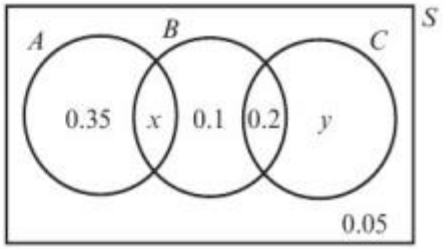
Hint Draw a Venn diagram to help you.

5 A patient going in to a doctor's waiting room reads *Hiya* magazine with probability 0.6 and *Dakor* magazine with probability 0.4. The probability that the patient reads either one or both of the magazines is 0.7. Find the probability that the patient reads:

a both magazines **(2 marks)**

b *Hiya* magazine only. **(2 marks)**

6 The Venn diagram shows the probabilities of members of a sports club taking part in various activities.



A represents the event that the member takes part in archery.

B represents the event that the member takes part in badminton.

C represents the event that the member takes part in croquet.

Given that $P(B) = 0.45$:

a find x **(1 mark)**

b find y. **(2 marks)**

Homework Exercise

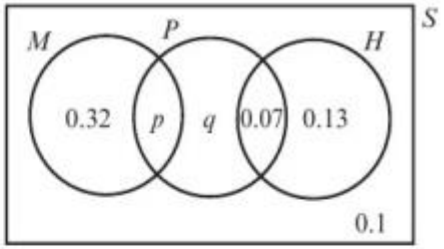
7 The Venn diagram shows the probabilities that students at a sixth-form college study certain subjects.

M represents the event that the student studies mathematics.

P represents the event that the student studies physics.

H represents the event that the student studies history.

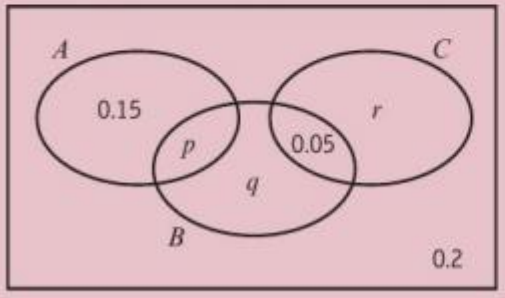
Given that $P(M) = P(P)$, find the values of p and q.



(4 marks)

Challenge

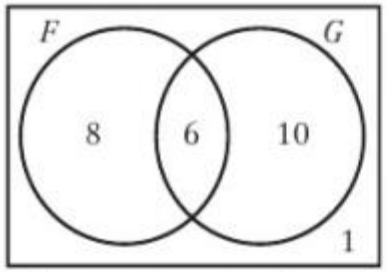
The Venn diagram shows the probabilities of a group of children liking three types of sweet.



Given that $P(B) = 2P(A)$ and that $P(\text{not } C) = 0.83$, find the values of p, q and r.

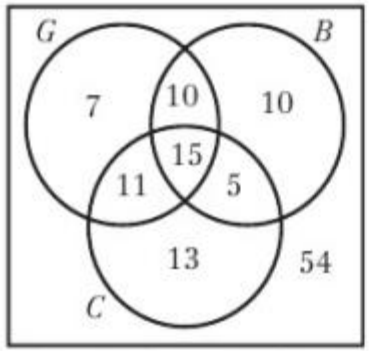
Homework Answers

1 a



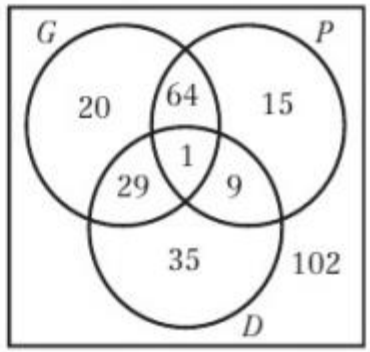
i $\frac{14}{25}$ **ii** $\frac{6}{25}$ **iii** $\frac{8}{25}$ **iv** $\frac{1}{25}$

2 a



b i $\frac{3}{25}$ **ii** $\frac{2}{25}$ **iii** $\frac{2}{25}$ **iv** $\frac{54}{125}$

3 a i



b i $\frac{89}{275}$ **ii** $\frac{103}{275}$ **iii** $\frac{14}{55}$ **iv** $\frac{102}{275}$

4 a 0.17
b 0.18
c 0.55

5 a 0.3
b 0.3

6 a 0.15
b 0.15

7 $p = 0.13$, $q = 0.25$

Challenge
$p = 0.115$, $q = 0.365$, $r = 0.12$