# Probability 1

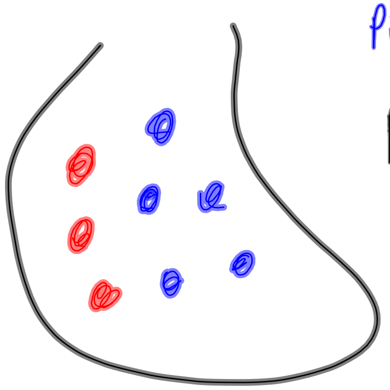
chapter 1

## Section 1.6 The multiplication law for independent events

PROJECT MATHS
Text & Tests 5
LEAVING CERTIFICATE
HIGHER LEVEL
STRAND 1
PROBABILITY & STATISTICS

30

Independent-if first event doesn't effect the probability of 2nd event.



Pick 2 balls (Replace)

$P(R) * P(B)$

$P(R \text{ then } B) = \left(\frac{3}{8}\right)\left(\frac{5}{8}\right)$

Independent

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Pick 2 balls (don't Replace)

$P(R) * P(B|R)$

Conditional → $P(R \text{ then } B) = \left(\frac{3}{8}\right)\left(\frac{5}{7}\right)$

dependent.

Paul spins a coin  and rolls a dice. 

His results are shown on the right.

The coin and the dice do not affect each other, so their outcomes are **independent**.

There are 12 equally likely outcomes of the coin and dice, as shown in the diagram on the right.

From the sample space, we can see that the probability of a head and a 5 is $\frac{1}{12}$.

The probability of each outcome can also be found by multiplying the separate probabilities, as shown above.

| Dice | H(ead) | T(ail) |
|---|---|---|
| 6 | H, 6 | T, 6 |
| 5 | H, 5 | T, 5 |
| 4 | H, 4 | T, 4 |
| 3 | H, 3 | T, 3 |
| 2 | H, 2 | T, 2 |
| 1 | H, 1 | T, 1 |

**Coin**

This illustrates the **multiplication law** of probability which states that for independent events A and B,

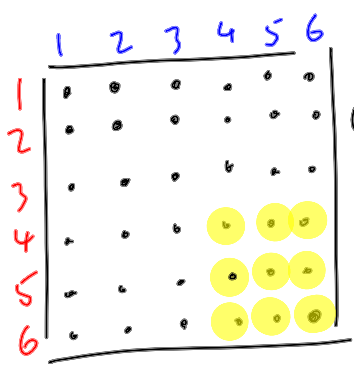
$P(\text{A and B}) = P(A) \times P(\text{B})$

This law is sometimes called the AND Rule.

The multiplication law applies to any number of independent events.

## Example 1 multiplication rule

When two dice are thrown, what is the probability of getting
(i) two sixes (ii) 4 or more on each die?



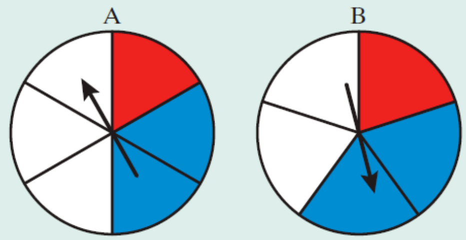

INDEPENDENT

(i) $P(6,6) = \left(\frac{1}{6}\right)\left(\frac{1}{6}\right) = \frac{1}{36}$

(ii) $P(\geq 4, \geq 4) = \left(\frac{1}{2}\right)\left(\frac{1}{2}\right) = \frac{1}{4}$

## Example 2

These two spinners are spun.
What is the probability that
(i) spinner A shows red
(ii) spinner B shows red
(iii) both spinners show red
(iv) A shows red and B shows blue
(v) both show blue
(vi) both show white
(vii) neither shows white?




independent events!

(i) $P(\text{Red on } A) = \frac{1}{6}$

(ii) $P(\text{Red on } B) = \frac{1}{5}$

(iii) $P(R, R) = \left(\frac{1}{6}\right)\left(\frac{1}{5}\right) = \frac{1}{30}$

(iv) $P(R, B) = \left(\frac{1}{6}\right)\left(\frac{2}{5}\right) = \frac{2}{30} = \frac{1}{15}$

(v) $P(B, B) = \left(\frac{2}{6}\right)\left(\frac{2}{5}\right) = \frac{4}{30} = \frac{2}{15}$

(vi) $P(W, W) = \left(\frac{1}{2}\right)\left(\frac{2}{5}\right) = \frac{2}{10} = \frac{1}{5}$

(vii) $P(\text{no } W) = \left(\frac{1}{2}\right)\left(\frac{3}{5}\right) = \frac{3}{10}$

## Example 3

A gambler must throw a 6 with a single dice to win a prize.
Find the probability that he wins at his third attempt.

$$P(\text{not } 6, \text{not } 6, 6) = \left(\frac{5}{6}\right)\left(\frac{5}{6}\right)\left(\frac{1}{6}\right) = \frac{25}{216}$$

## Example 4

Three pupils $A$, $B$ and $C$ have their birthdays in the same week.
What is the probability that the three birthdays
(i) fall on a Monday
(ii) fall on the same day
(iii) fall on three different days?

(i) $P(m, m, m) = \left(\frac{1}{7}\right)\left(\frac{1}{7}\right)\left(\frac{1}{7}\right) = \frac{1}{343}$

(ii) $P(\text{same day}) = 7 \times$ Probability all on particular day

$= \frac{7}{343} = \frac{1}{49}$

(iii) $P(\text{all different days}) = \underbrace{(1)}_{\text{1st person}}\underbrace{\left(\frac{6}{7}\right)}_{\text{2nd person}}\underbrace{\left(\frac{5}{7}\right)}_{\text{3rd person}}$

not independent

$= \frac{30}{49}$