MATHS FIELD GUIDE · GRADE 7

Probability models describe possible outcomes

OPENING PROBLEM

Two independent fair coins. What is P(exactly one head)?

First	Second
H	H
H	T
T	H
T	T

02 Count paths through two stages
03 Rules and worked cases
04 Two draws from a bag
05 Count outcomes exactly once
06 Check your reasoning

ILLUSTRATED PROBLEM SHEET

Count paths through two stages

List ordered results or multiply probabilities along a path. State what the first draw changes.

1

First	Second
H	H
H	T
T	H
T	T

Two independent fair coins. What is P(exactly one head)?

Two of four paths, HT and TH. Probability 1/2.

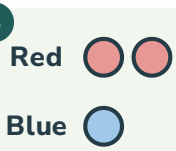
2



Two draws without replacement. What is P(two reds)?

First 2/3, then 1/2. Their product is 1/3.

3



Replace the first counter before drawing again. P(two reds)?

Now both draws have probability 2/3. Multiply to get 4/9.

4

Die 1	Die 2	Sum
1	3	4
2	2	4
3	1	4

Are there three equally likely ways to get four with two independent fair six-sided dice?

Yes. The full ordered grid has 36 cells. Three winning cells give 1/12.

Two fair independent tosses, both heads
1/4.

At least one head
1 − 1/4 = 3/4.

CHAPTER PROBLEM

Why is the probability of exactly one head from two fair coin tosses one half?

Two of the four equally likely ordered outcomes, HT and TH, have exactly one head.

MATHS REFERENCE · GRADE 7

Probability models describe possible outcomes

A probability model specifies possible outcomes and their probabilities. A sample space lists the possible outcomes for an experiment.

For equally likely outcomes, an event's probability is its number of favourable outcomes divided by the total number of outcomes.

Four cases to recognise

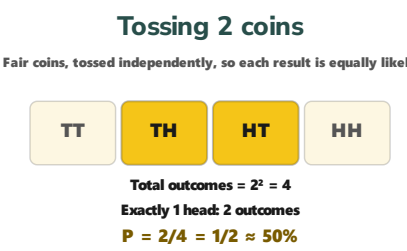
Situation	What to do and why
Fair coin and fair die	2 × 6 = 12 equally likely ordered outcomes if independent.
Head and even number	Three of twelve outcomes qualify: probability 1/4.
Two distinct fair coins, exactly one head	HT and TH qualify; 2/4 = 1/2.
Two fair dice, at least one six	Complement: neither has a six, probability 25/36. Required chance 11/36.

Read the model

Build the idea

Toss two fair coins and record order. The sample space is HH, HT, TH and TT. Each ordered result has probability one quarter.

Exactly one head occurs in HT or TH. Two of four outcomes give probability one half.



Why it works

Writing outcomes systematically avoids missing possibilities or counting them twice. "One head" is not just one outcome because the head can occur in either position.

Experimental probability counts observed successes divided by trials. It estimates rather than dictates future results.

sample space All possible outcomes.
theoretical probability Chance given by a model.
experimental probability Observed success proportion.

Heads	Tosses	Share
3	4	3/4
5	10	1/2

Which trial set landed closer to half heads?

The second. The first did not disprove a fair-coin model.

WORKED INVESTIGATION

Two draws from a bag

A bag contains two red counters and one blue. Draw one, replace it, mix, then draw again. A particular red counter has the same chance as the blue counter.

Look at this part	What it tells you
First draw red	2/3
Red again after replacement	2/3
Both red	4/9

Work it through

Label the red counters R1 and R2. Nine ordered counter pairs are equally likely, and four have two red counters.

Catch the mistake

Treating RR, RB, BR and BB as four equally likely colour outcomes ignores the different numbers of counter pairs behind those names.

Compare the cases

Follow an example

A spinner lands on blue 38 times in 100 trials. Its experimental blue probability is 0.38.

A theoretical value of 0.4 is compatible with such a result: random variation need not produce the exact theoretical proportion.

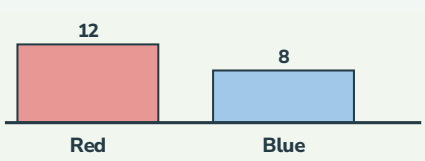
What changes? What stays true?

More trials often give a more stable estimate, but do not guarantee exact agreement. A biased process can also give misleading data.

Do not assume outcomes are equally likely because their names appear in a list. The physical experiment or model must justify equal likelihood.

Change one condition

Without replacement, after a red draw only one red remains among two counters. Both red then has probability (2/3) × (1/2) = 1/3.



Estimate the chance of red from these twenty draws.

12/20 = 3/5. Record whether each counter was replaced before comparing trials.

ILLUSTRATED PROBLEM SHEET

Count outcomes exactly once

The counting unit depends on whether order matters and whether an object can be used twice.

1

First	Possible next
A	B or C
B	A or C
C	A or B

Choose a captain then a deputy from three pupils. How many results?

Three choices, then two remaining choices. Six ordered outcomes.

2

AB and BA
↓
Same two-person team
↓
6 ÷ 2 = 3

What if the two roles disappear?

Each unordered pair was counted twice. There are three teams.

3

Die A	Die B
1	5
2	4
3	3
4	2
5	1

How many ordered two-die results give sum six?

Five out of 36 for independent fair dice. The double (3,3) appears once.

4

Tickets 1 to 12
↓
Multiples of 2: 6
↓
Multiples of 3: 4

How many are multiples of 2 or 3?

Subtract the two overlaps, 6 and 12. The union has 6 + 4 − 2 = 8 tickets.

Four pupils in two distinct roles
4 × 3 = 12.

Two-person teams from four
12 ÷ 2 = 6.

CHAPTER PROBLEM

A fair six-sided die is rolled. Find the probability that the score is greater than 4.

The favourable scores are 5 and 6. Each of the six scores is equally likely, so the probability is 2/6 = 1/3.

QUESTION BANK · FOLD OR COVER THE RIGHT COLUMN

Check your reasoning

Try the problem	Solution and reasoning
01 Why do HT and TH count separately?	The first and second tosses occupy different positions, even when the number of heads matches.
02 Is an unordered pair of die faces always as likely as any other unordered pair?	No. A non-double has two orders; a double has one.
03 With replacement, what is the chance of seeing at least one blue?	The only way to see no blue is red twice, with probability 4/9. Its complement is 5/9.
04 Two fair coins show matching faces. List the favourable pairs and chance.	HH and TT out of four equally likely ordered pairs give 1/2.
05 A spinner has red on half and green on half. Is a two-spin outcome of two reds guaranteed in four attempts?	No. Its probability is 1/4 for independent spins, not a schedule for a specific four attempts.

Set	Hits	Tries
A	3	5
B	9	15

Combine the evidence.

Twelve hits in twenty tries gives 3/5. Pool counts before dividing.

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