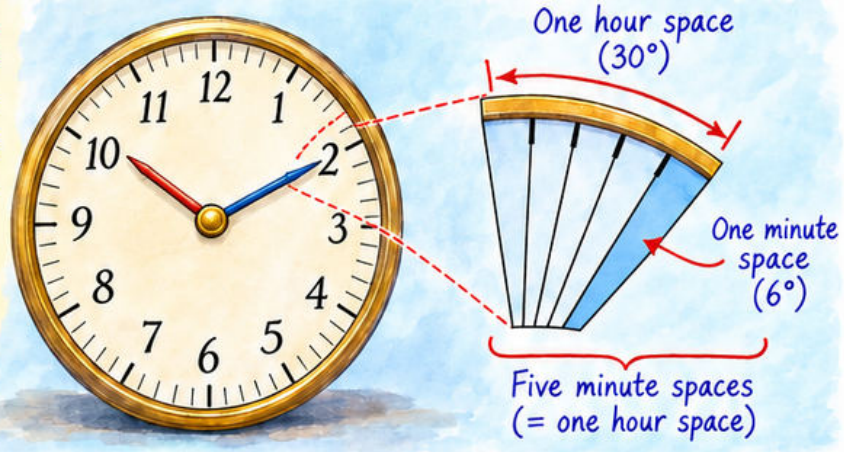
Two moving hands one relative speed

The dial in two units

A clock has 60 minute spaces of 6° each and 12 hour spaces of 30° each. One hour space contains five minute spaces. A minute space measures distance around the diai; a minute measures elapsed time.



Both hands move

The minute hand turns 6° per minute. The hour hand turns 0.5°, or one-half degree, per minute. Their relative speed is $6 - 0.5 = 5.5°$, or $11/2°$, per minute.

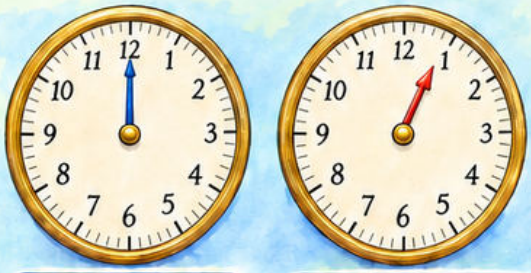
Minute hand — 6° per minute

Hour hand — 0.5° per minute

Relative speed
$= 6 - 0.5$
$= 5.5°$
$= \frac{11}{2}°$
per minute.

Gain in one hour

In 60 minutes, the minute hand covers 60 spaces while the hour hand moves five. The gain is therefore 55 spaces, equivalent to 330°. In one minute, the gain is $11/12$ of a space.



Minute hand:
60 spaces
(in 60 minutes)

Hour hand:
5 spaces
(in 60 minutes)

Gain:
$60 - 5 = 55$
spaces
$= 330°$.

In one minute, the gain is $11/12$ of a space.

Time to close a gap

One degree of relative gain takes $2/11$ minute. One minute space takes $12/11$ minutes. To gain g spaces, use time $= \frac{12g}{11}$ minutes.

Do not put a degree value straight into this space formula: 30° is five spaces, so its gain time is $60/11$ minutes.



$1°$ of gain $\rightarrow \frac{2}{11}$ minute

1 space $\rightarrow \frac{12}{11}$ minutes

g spaces $\rightarrow$ time $= \frac{12g}{11}$ minutes

$30° = 5$ spaces
$\rightarrow$ gain time $= \frac{60}{11}$ minutes.

Sources: Day 29 Source Index | Topic 288

One method handles three positions

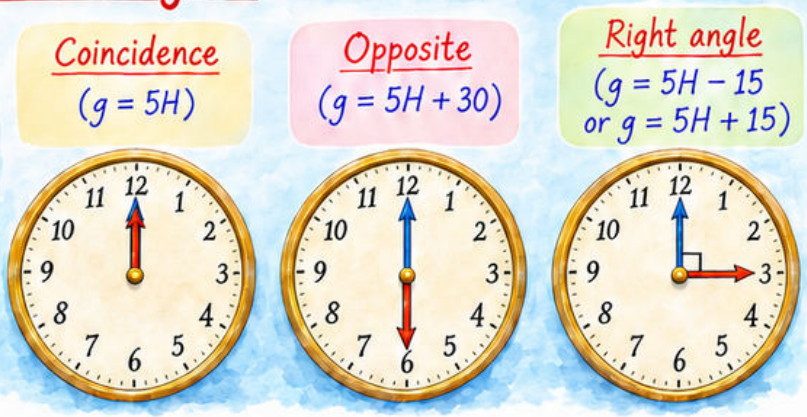
Start at H o'clock

Use $H = 0$ at twelve. At H o'clock, the minute hand points to twelve and the hour hand is 5H minute spaces ahead. That initial lead is the starting gap.



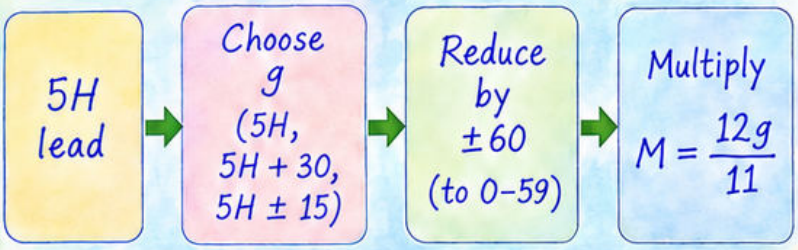
Choose the required relative gain

For coincidence, use $g = 5H$. For opposite hands, use $g = 5H + 30$. For a right angle, test both $g = 5H - 15$ and $g = 5H + 15$. The required separation is zero, thirty or fifteen spaces respectively.



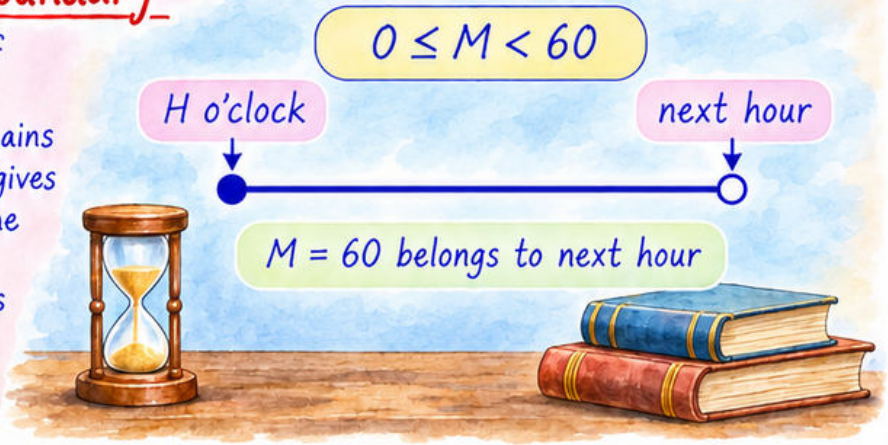
Reduce by full laps

Add or subtract sixty spaces to bring the gain into the range zero to fifty-nine. A relative gain differing by a whole lap gives the same hand relationship. Then compute $M = \frac{12g}{11}$ minutes after H.



Check the hour boundary

Keep a candidate only if $0 \le M < 60$ for the hour beginning at H. For the gains in these problems, $g = 55$ gives $M = 60$ and belongs to the next hour. The half-open interval convention counts a boundary event once, never twice.

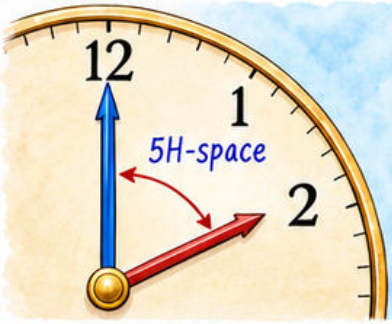


Sources: Day 29 Source Index | Topic 288

Coincidences in the first half of the dial

Derive the formula

Coincidence means closing the initial 5H-space lead. Thus M = 5H × 12/11 = 60H/11 minutes after H. The hour hand's continuing motion is already included in the relative-speed factor.



Initial lead of HOUR hand = 5H spaces

M = 5H × 12/11 = 60H/11 (minutes after H)

From one to three

Between one and two, gain five spaces: M = 60/11 = 5 5/11 minutes past one.

Between two and three, gain ten: M = 120/11 = 10 10/11 minutes past two.



5 5/11 minutes past one



10 10/11 minutes past two

From three to five

Between three and four, gain fifteen: M = 180/11 = 16 4/11 minutes past three.

Between four and five, gain twenty: M = 240/11 = 21 9/11 minutes past four.



16 4/11 minutes past three



21 9/11 minutes past four

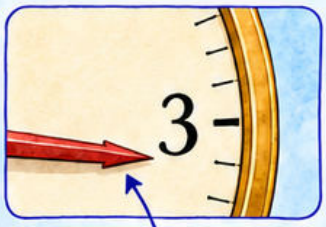
From five to six

Gain twenty-five spaces: M = 300/11 = 27 3/11 minutes past five.

The tempting answer 3:15 for the earlier example is wrong because the hour hand has moved beyond three. Exact fractional minutes avoid unnecessary rounding and make the common 60/11 pattern visible.



27 3/11 minutes past five



Hour hand has moved beyond three

H	Gain (spaces)	Coincidence M (minutes past H)
1	5	5 5/11 minutes past one
2	10	10 10/11 minutes past two
3	15	16 4/11 minutes past three
4	20	21 9/11 minutes past four
5	25	27 3/11 minutes past five



Sources: Day 29 Source Index | Topic 288

Coincidences from six to twelve

Six seven and eight

For $H = 6$, gain thirty spaces: $360/11 = 32\ 8/11$ minutes past six.

For $H = 7$, gain thirty-five: $420/11 = 38\ 2/11$ past seven.

For $H = 8$, gain forty: $480/11 = 43\ 7/11$ past eight.



Nine and ten

For $H = 9$, gain forty-five spaces: $540/11 = 49\ 1/11$ minutes past nine.

For $H = 10$, gain fifty: $600/11 = 54\ 6/11$ past ten.

H	Gain (spaces)	Coincidence time
6	30	32 8/11 min past six
7	35	38 2/11 min past seven
8	40	43 7/11 min past eight
9	45	49 1/11 min past nine
10	50	54 6/11 min past ten
11	55	60 min (12:00)

The eleven-to-twelve exception

For $H = 11$, gain fifty-five spaces: $660/11 = 60$ minutes. This is exactly twelve o'clock, not a coincidence strictly between eleven and twelve. Between eleven and one there is just one, at twelve.



Verify the seven-o'clock example

At $M = 420/11$, the minute hand's relative angular gain is $5.5 \times 420/11 = 210°$. This equals 30×7, the initial lead. Therefore $|210 - 210| = 0°$, confirming coincidence.

Every listed result includes movement of both hands.



7:38 2/11 • hands coincide

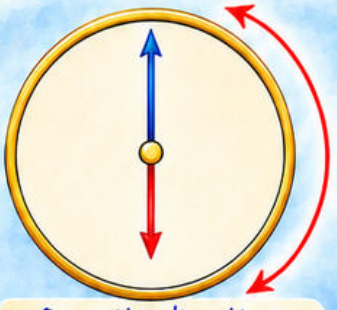
At $M = 420/11$, relative gain $= 5.5 \times 420/11$ $= 210°$ $= 30 \times 7$ (initial lead).

Sources: Day 29 Source Index | Topic 288

Opposite hands before and after six

Add half a circle

Opposite hands are thirty spaces, or 180°, apart. Start with $g = 5H + 30$. For $H = 0$ to 4, this gives gains from thirty to fifty spaces, all within the hour.



Opposite directions (schematic)

$g = 5H + 30$
$(H = 0$ to $4)$
$g = 30, 35, 40, 45, 50$
(all within the hour)

Before six

Between two and three, $g = 40$, so $M = 480/11 = 43\frac{7}{11}$ minutes past two.

Between three and four, $g = 45$, so $M = 540/11 = 49\frac{1}{11}$ past three.

Check: $|90 - 270| = 180°$.



Between two and three
$M = 43\frac{7}{11}$

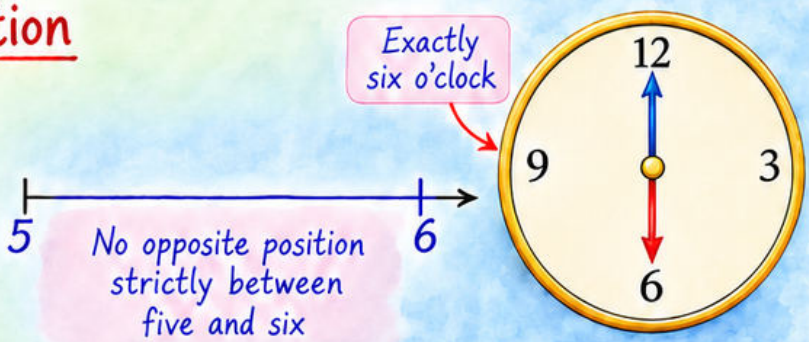


Between three and four
$M = 49\frac{1}{11}$

The boundary exception

At $H = 5$, $g = 55$ gives sixty minutes: exactly six o'clock. There is no opposite position strictly between five and six.

At $H = 6$, reduce sixty spaces to zero, giving six o'clock itself.



After six

For $H = 6$ to 11, subtract sixty from $5H + 30$ to use $g = 5H - 30$.

Between eight and nine, $g = 10$ gives $10\,{}^{10}/_{11}$ minutes past eight.

Between nine and ten, $g = 15$ gives $16\,{}^{4}/_{11}$ past nine; $|270 - 90| = 180°$.

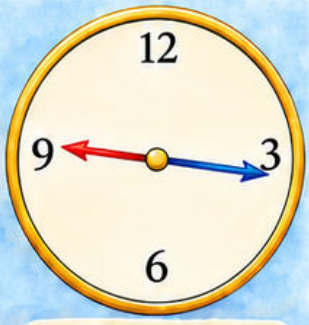
$g = 5H - 30$
$(H = 6$ to $11)$

Between eight and nine
$M = 10\frac{10}{11}$

Between nine and ten
$M = 16\frac{4}{11}$



Between eight and nine
$M = 10\frac{10}{11}$



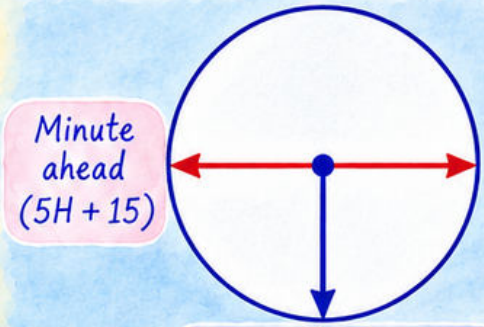
Between nine and ten
$M = 16\frac{4}{11}$

Sources: Day 29 Source Index | Topic 288

Right angles have two possible sides

Two gains to test

A right angle is fifteen spaces, or 90°, from the hour hand. The minute hand may be behind or ahead, so calculate both 5H − 15 and 5H + 15, reducing by a full sixty-space lap when needed.



Relative-position schematic, not a clock reading

Between five and six

The initial lead is twenty-five spaces. Gains are ten and forty. Times are 120/11 = 10 10/11 minutes and 480/11 = 43 7/11 minutes past five.

H5 computation

Initial: 25 spaces

g10 | g40

Gain (spaces)

$\frac{120}{11} = 10\frac{10}{11}$ minutes past five

$\frac{480}{11} = 43\frac{7}{11}$ minutes past five

Between six and seven

The lead is thirty spaces. Gains fifteen and forty-five give 180/11 = 16 4/11 and 540/11 = 49 1/11 minutes past six. Substitution gives |180 − 90| = 90° and |180 − 270| = 90°.

H6 computation

Initial: 30 spaces

g15 | g45

Gain (spaces)

$\frac{180}{11} = 16\frac{4}{11}$ minutes past six

$\frac{540}{11} = 49\frac{1}{11}$ minutes past six

$|180 - 90| = 90°$
$|180 - 270| = 90°$

Between eleven and twelve

The lead is fifty-five spaces. One gain is forty; the other is seventy, reduced to ten. Thus the times are 43 7/11 and 10 10/11 minutes past eleven. Testing only one sign loses a valid event. Both results should be ordered chronologically when presenting the final pair.

H11 computation

Initial: 55 spaces

g40 | g70 → 10

Gain (spaces)

70 → 10 (reduced by 60)

$43\frac{7}{11}$ minutes past eleven

$10\frac{10}{11}$ minutes past eleven

Sources: Day 29 Source Index | Topic 288

Why two hours have only one right angle

Between two and three

The gains are $10 - 15 = -5$ and $10 + 15 = 25$. Add sixty to the negative candidate: $-5 + 60 = 55$, which produces $M = 60$, exactly three o'clock.



The valid interior result

Only $g = 25$ remains inside two-to-three. It gives $M = 300/11 = 27\ 3/11$ minutes past two. The right angle at three belongs to the hour beginning at three under the counting convention.



Between eight and nine

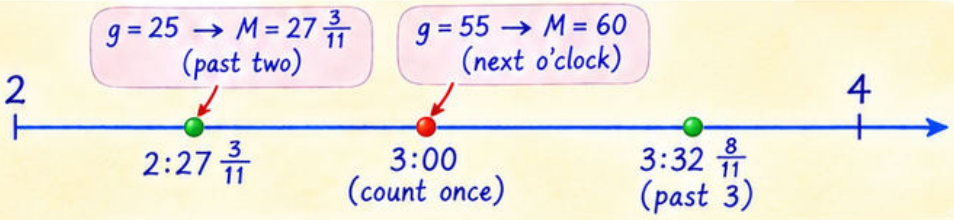
The gains are $40 - 15 = 25$ and $40 + 15 = 55$. Again, fifty-five means the next exact hour. Thus there is one interior event, at $27\ 3/11$ minutes past eight; $|240 - 150| = 90°$.



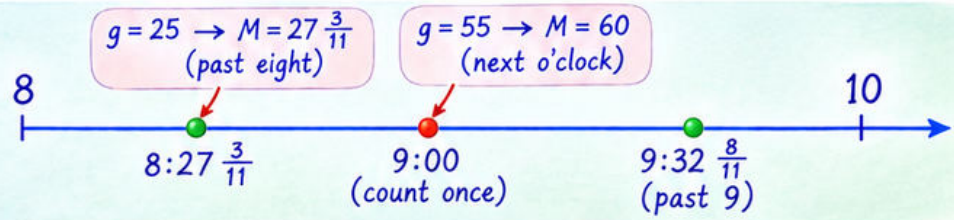
Count the boundary once

Most hours contain two right-angle events. The two-to-three and eight-to-nine hours contain only one each. Equivalently, the two-hour spans two-to-four and eight-to-ten contain three events, not four. Three o'clock and nine o'clock must not be counted on both sides of the hour boundary.

Two-to-four: three events (not four)



Eight-to-ten: three events (not four)



Sources: Day 29 Source Index | Topic 288

Use the angle formula as a check

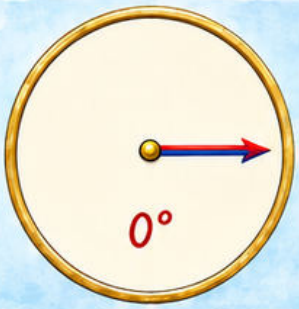
The angular separation

At H hours and M minutes, compute $|30H - 5.5M|$. It gives the angular separation before choosing the smaller of an angle and its reflex counterpart. The required values here are zero, 180°, or 90° and 270°.



Check a coincidence

Between seven and eight, $M = 420/11$. Then $5.5M = 210 = 30 \times 7$, so the result is zero. Solving $30H - 5.5M = 0$ also directly gives $M = 60H/11$.

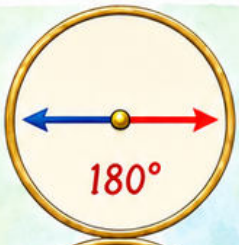


$H = 7, \quad M = 420/11$
$30H - 5.5M$
$= 30 \times 7 - 5.5 \times 420/11$
$= 210 - 210 = 0$

0°

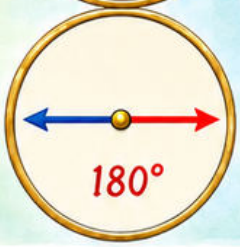
Check opposition

Between three and four, $M = 540/11$. The formula gives $|90 - 270| = 180°$. Between nine and ten, $M = 180/11$ gives $|270 - 90| = 180°$. Opposite positions can arise before or after the minute hand catches the hour hand.



$H = 3, \quad M = 540/11$
$|30H - 5.5M|$
$= |90 - 270| = 180°$

180°



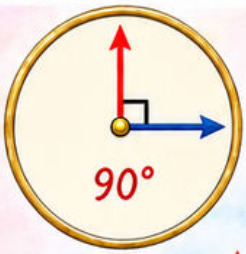
$H = 9, \quad M = 180/11$
$|30H - 5.5M|$
$= |270 - 90| = 180°$

180°

Check a right angle

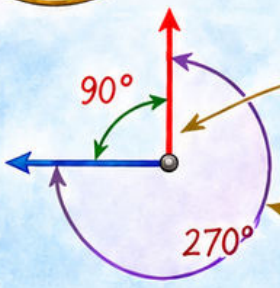
Between eight and nine, $M = 300/11$ gives $|240 - 150| = 90°$. A computed 270° also represents a 90° smaller angle.

Keep units consistent: 5.5 is degrees per minute, while 12/11 is minutes per minute-space of relative gain.



$H = 8, \quad M = 300/11$
$|30H - 5.5M|$
$= |240 - 150| = 90°$

90°



Minor angle: 90°

Reflex angle: 270°

Sources: Day 29 Source Index | Topic 288

Count events over twelve hours and a day

Coincident and opposite

In a twelve-hour cycle there are eleven coincidences and eleven opposite-hand events. Each occurs twenty-two times in twenty-four hours. The missing interior intervals are eleven-to-twelve for coincidence and five-to-six for opposition.



Event	In 12 hours	In 24 hours
Coincidence	11	22
Opposite hands	11	22

Right angles

Start from two per hour: 2 × 12 = 24. Subtract one for two-to-three and one for eight-to-nine. The result is twenty-two right angles in twelve hours and forty-four in a day.



Right angles	
In 12 hours	22
In a day	44

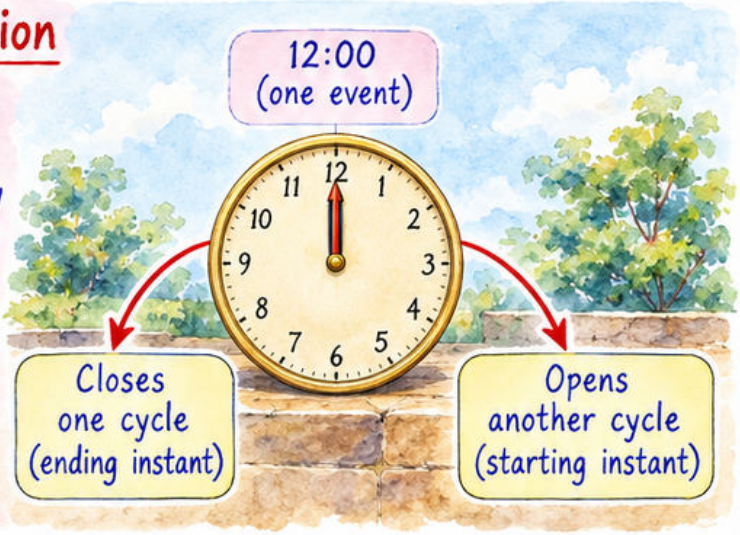
One straight line

Hands in the same straight line may coincide or point oppositely. Count both: 11 + 11 = 22 events in twelve hours, or forty-four in twenty-four. Counting only opposite hands misses half of them.

Straight line (both)	In 12 hours	In 24 hours
Coincide	11	22
Opposite	11	22
Total	22	44

Endpoints need a convention

Use a full cycle that includes its starting instant and excludes its ending instant, so the same boundary is counted once. Twelve o'clock closes one cycle and opens another but is still one event. For an arbitrary stated interval, inspect its endpoints separately rather than automatically applying a whole-day total.



Sources: Day 29 Source Index | Topic 288

Worked counts and straight-line times

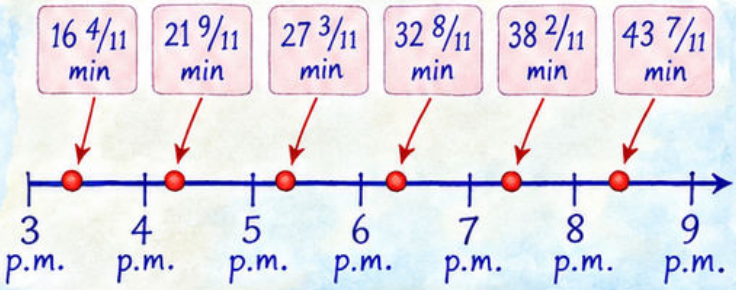
Coincidences from 3 p.m. to 9 p.m.

Neither endpoint is a coincidence. There is one in each hour beginning at three, four, five, six, seven and eight, giving six events.



Locate the six events

The minute offsets are respectively 16 4/11, 21 9/11, 27 3/11, 32 8/11, 38 2/11 and 43 7/11. Matching each offset to its own hour is essential; these are not six times within a single hour.



Straight line between ten and eleven

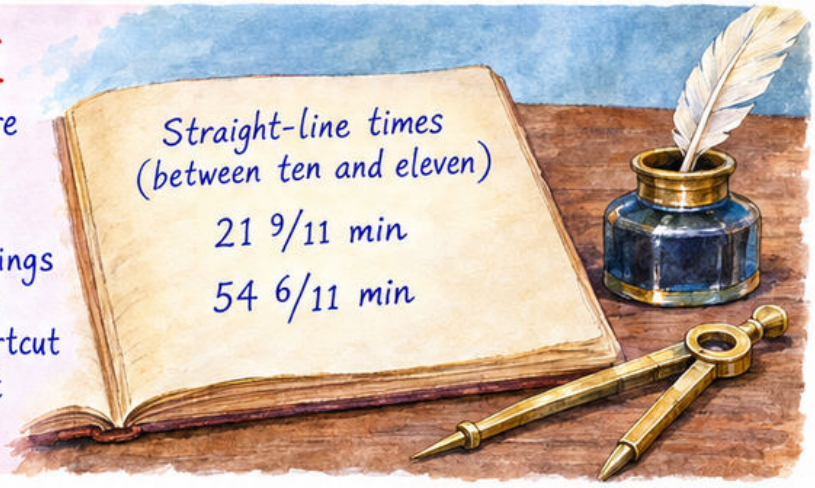
Coincidence needs $g = 50$, giving $M = 600/11 = 54\ 6/11$ minutes past ten.

Opposition needs $g = 50 + 30 = 80$, reduced to twenty, giving $M = 240/11 = 21\ 9/11$ minutes past ten.



Present both in order

The two straight-line times are therefore 21 9/11 and 54 6/11 minutes past ten. This worked example combines the two meanings of straight line and the full-lap reduction. No multiple-choice shortcut replaces identifying the correct geometrical relationship first.

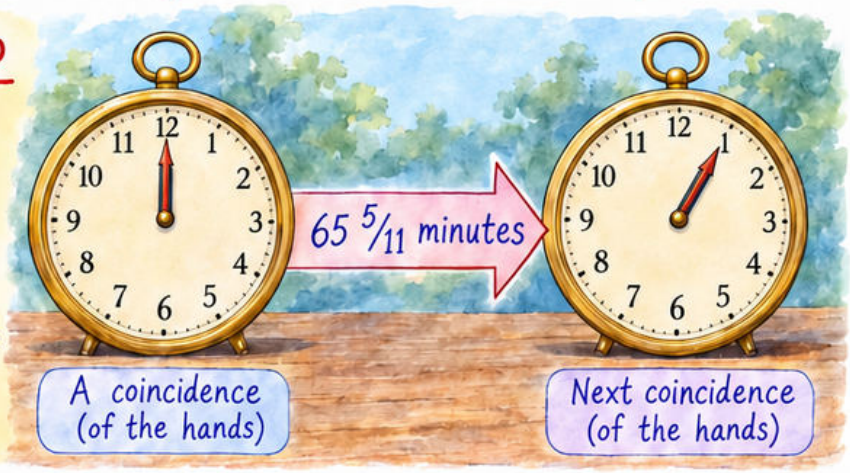


Sources: Day 29 Source Index | Topic 288

Successive meetings are not an hour apart

Gain a complete lap

After a coincidence, the minute hand must gain sixty spaces to meet the hour hand again. At 12/11 minutes per gained space, the interval is $60 \times 12/11 = 720/11 = 65\ 5/11$ minutes.



Another derivation

Twelve hours contain 720 minutes and eleven coincidence intervals. Dividing 720 by eleven gives the same $65\ 5/11$-minute spacing. The minute hand's own sixty-minute revolution is not its revolution relative to the moving hour hand.

12 hours = 720 minutes

Coincidence intervals = 11

$720 \div 11 = 65\ 5/11$ minutes

Find the next meeting

Start at $10\ 10/11$ minutes past two. Add one hour and $5\ 5/11$ minutes. The sum is three hours and $16\ 4/11$ minutes, matching the coincidence formula for $H = 3$.

$$\begin{array}{r} 2 : 10\ 10/11 \\ +\ 1 : 05\ 5/11 \\ \hline 3 : 16\ 4/11 \end{array}$$



Correct-time comparison

If a normally geared clock's hands meet every 64 minutes of correct external time, its meeting interval is $1\ 5/11$ minutes too short, so the clock runs fast. The next panel calculates the gain. Always state which clock measures the interval; an unsupported claim that this means a loss is incorrect.



Sources: Day 29 Source Index | Topic 288

A sixty-four-minute meeting interval means gain

Specify true time

Assume a standard clock with a twelve-to-one hand-speed ratio. Its hands coincide every 720/11, or 65 5/11, minutes of its own displayed time. Suppose observers measure only 64 minutes of correct external time between those meetings.



Calculate its rate

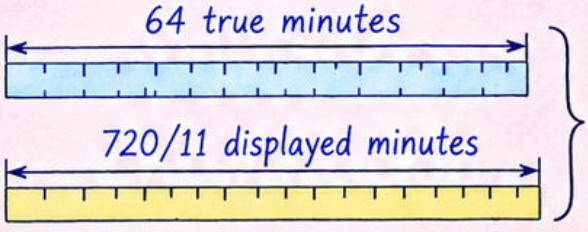
The clock advances 720/11 displayed minutes during 64 true minutes. Its rate is therefore (720/11) ÷ 64 = 45/44 times the correct rate. Since 45/44 exceeds one, the clock is fast, not slow.

$$\text{Rate} = (720/11) \div 64$$
$$= 720/11 \times \frac{1}{64}$$
$$= 45/44$$

Convert to a daily gain

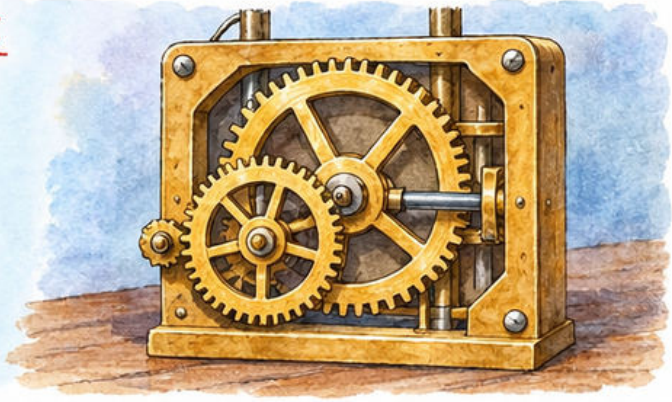
The excess rate is 45/44 − 1 = 1/44. A true twenty-four-hour day contains 1,440 minutes, so the gain is 1,440/44 = 360/11 = 32 8/11 minutes per true day.

$$\text{Gain} = 1{,}440/44$$
$$= 360/11$$
$$= 32\ 8/11 \text{ minutes per true day.}$$



Keep the premise consistent

Uniform speeding or slowing cannot change the displayed coincidence interval of standard-geared hands. Calling the sixty-four minutes the watch's own displayed interval would be inconsistent with that mechanism. The valid problem uses true time and asks for a gain.

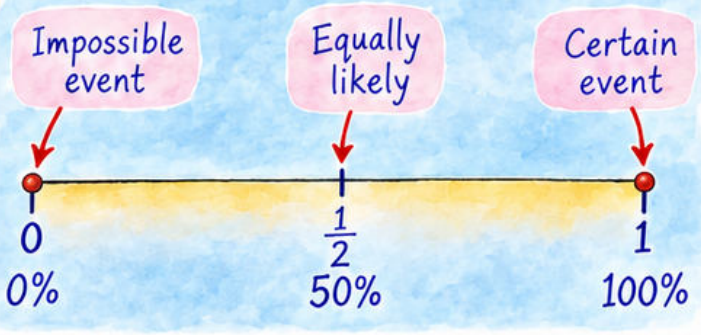


Sources: Day 29 Source Index | Topic 288

Probability measures likelihood

A number from zero to one

Probability describes how likely an event is. Zero means impossible and one means certain. Values can be written as reduced fractions, decimals or percentages, but all represent the same likelihood.



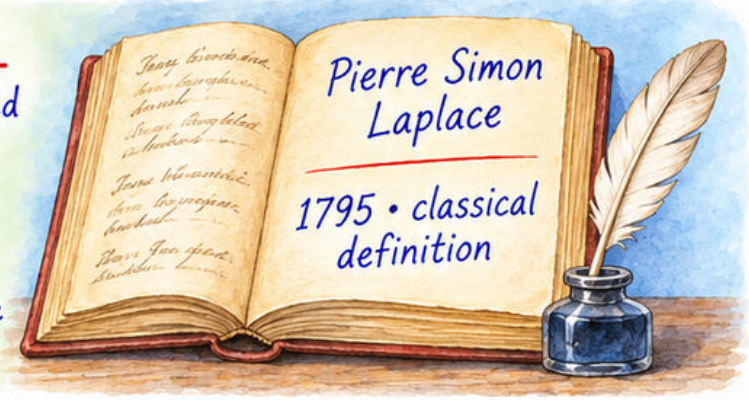
Experimental probability

Count how many trials produced the event and divide by the total trials. In an example of 1,000 coin tosses, 455 heads give 455/1,000 = 0.455. Another set of 1,000 tosses may give a different result.



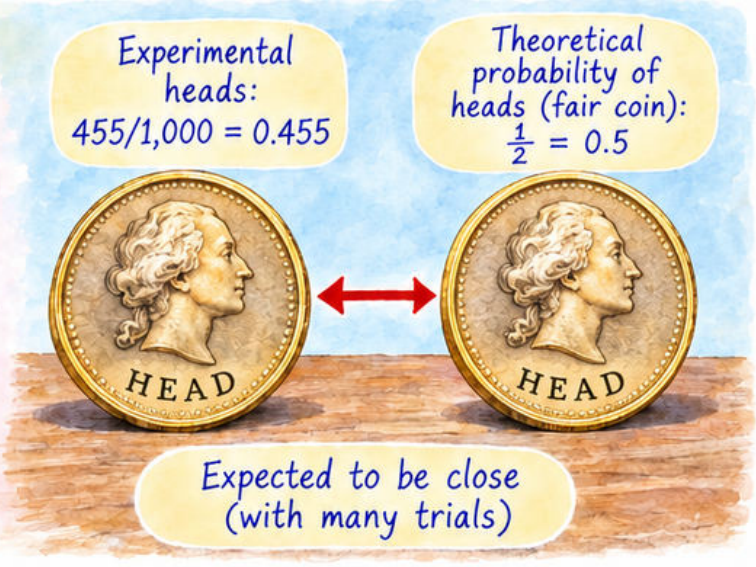
Theoretical probability

Classical probability is calculated from possible outcomes without carrying out the experiment. It requires equally likely outcomes. NCERT attributes the classical definition to Pierre Simon Laplace in 1795.



How the two relate

With many trials, experimental and theoretical probabilities are expected to be close, though a finite run need not match exactly. Probability is a part-to-whole comparison, like a ratio of favourable outcomes to all outcomes. It is not a comparison of favourable outcomes with unfavourable outcomes. Check the denominator before simplifying or converting the answer.



Sources: Day 29 Source Index | Topic 289

Experiment outcome and event

Experiment and trial

A random experiment is an action whose result cannot be predicted in advance, such as tossing a coin, throwing a die or drawing a card. One performance is a trial: one toss is one coin-toss trial.



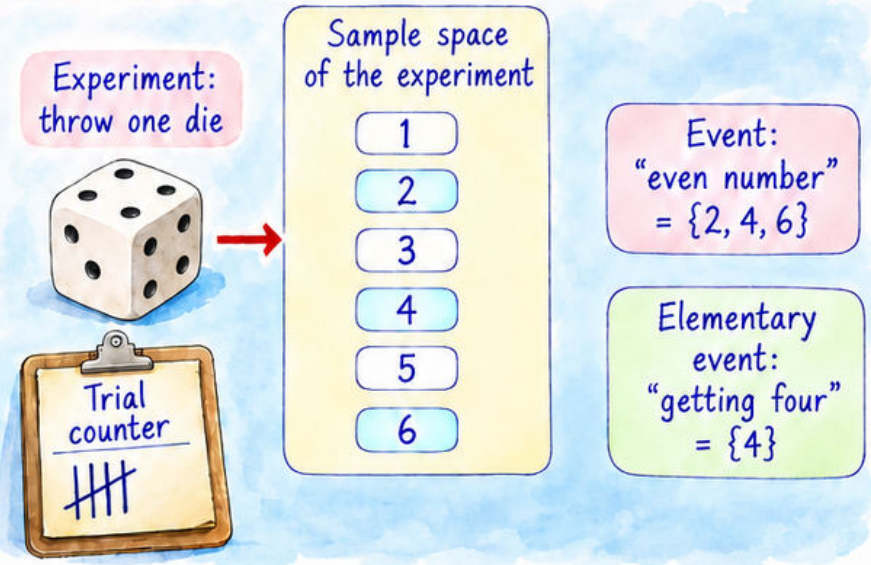
Outcome and sample space

An outcome is one possible result, such as five on a die. The full collection of possible outcomes is the sample space. For one die it is 1, 2, 3, 4, 5, 6.



An event collects outcomes

An event is a collection of outcomes favourable to a stated condition. The event "even number" contains two, four and six. An elementary event contains only one outcome, such as "getting four".



Equal likelihood

Equally likely outcomes each have the same chance. Head and tail for a fair coin, and all six faces of a fair die, satisfy this condition. The words fair, unbiased, at random and well-shuffled usually signal the intended equal-likelihood assumption. Identify the elementary outcomes first rather than assuming every named category is equally likely.



Sources: Day 29 Source Index | Topic 289

Count objects not unequal categories

The classical formula

P(E) equals the number of outcomes favourable to event E divided by the number of all possible outcomes, provided the elementary outcomes are equally likely. The condition is part of the formula, not an optional extra.

$$P(E) = \frac{\text{number of outcomes favourable to event } E}{\text{number of all possible outcomes}}$$

(elementary outcomes equally likely)

The coloured-ball trap

A bag holds four red balls and one blue ball. If each ball is equally likely to be drawn, there are five elementary outcomes. Four are red, so $P(\text{red}) = \frac{4}{5} = 80$ per cent.



Five equally likely balls: 4 red, 1 blue

$$P(\text{red}) = \frac{4}{5} = 80 \text{ per cent}$$

Why one-half is wrong

Red and blue are two colour names, but they are not equally likely categories. Counting colours would incorrectly give one-half. The denominator must count the five equally likely balls, and the numerator must count the four favourable balls.

Counting colours (incorrect): ~~$\frac{1}{2}$~~

Counting balls (correct): $\frac{4}{5}$

Apply the same discipline

For two coins, distinguish which coin shows each face. For two dice, distinguish the first die from the second. Category labels such as one head, one tail or a particular sum can contain different numbers of elementary outcomes. Equal-looking labels do not guarantee equal probability.

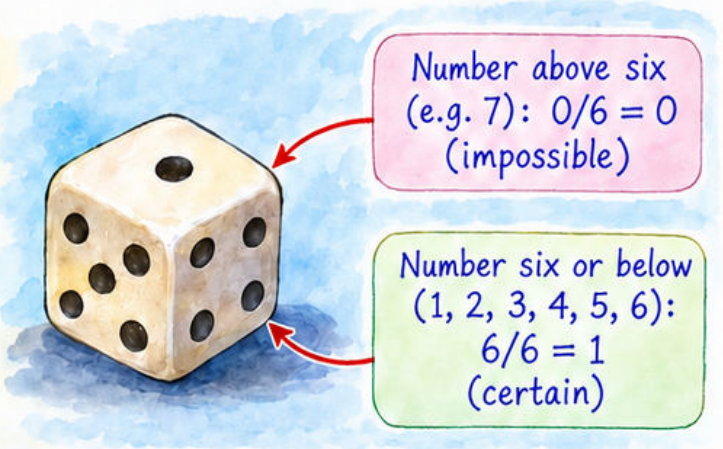


Sources: Day 29 Source Index | Topic 289

Complements impossible events and certainty

Impossible and certain

An impossible event has no favourable outcome and probability zero. A sure event includes every possible outcome and has probability one. On one die, a number above six gives $0/6 = 0$; a number six or below gives $6/6 = 1$.



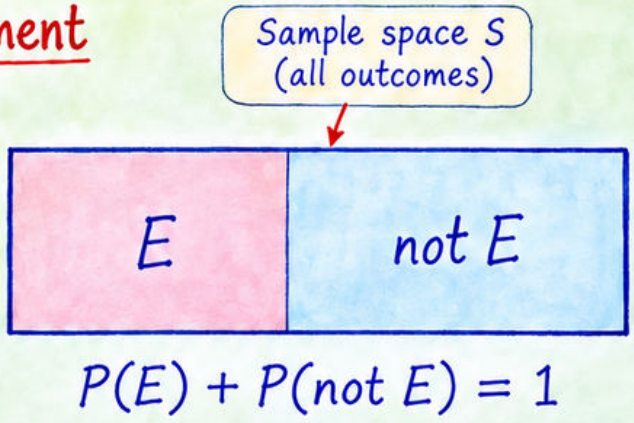
Two-dice examples

A sum of thirteen is impossible: $0/36 = 0$. A sum of twelve or less is certain: $36/36 = 1$. In any finite equally likely sample space, $0 \leq P(E) \leq 1$.



An event and its complement

The complement, not E, occurs exactly when E does not. The two share no outcomes and together cover the whole sample space. Therefore $P(E) + P(\text{not } E) = 1$, or $P(\text{not } E) = 1 - P(E)$.

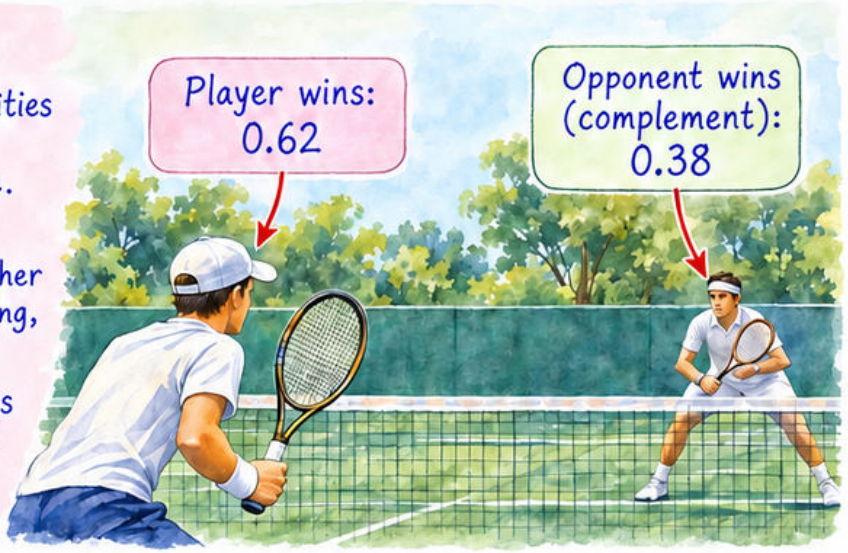


Useful checks

All elementary-event probabilities add to one; six die-face probabilities of 1/6 total one.

If one tennis player's win probability is 0.62 and the other outcome is the opponent winning, the complement is 0.38.

Opposite-sounding descriptions are complementary only when they leave nothing out and overlap nowhere.



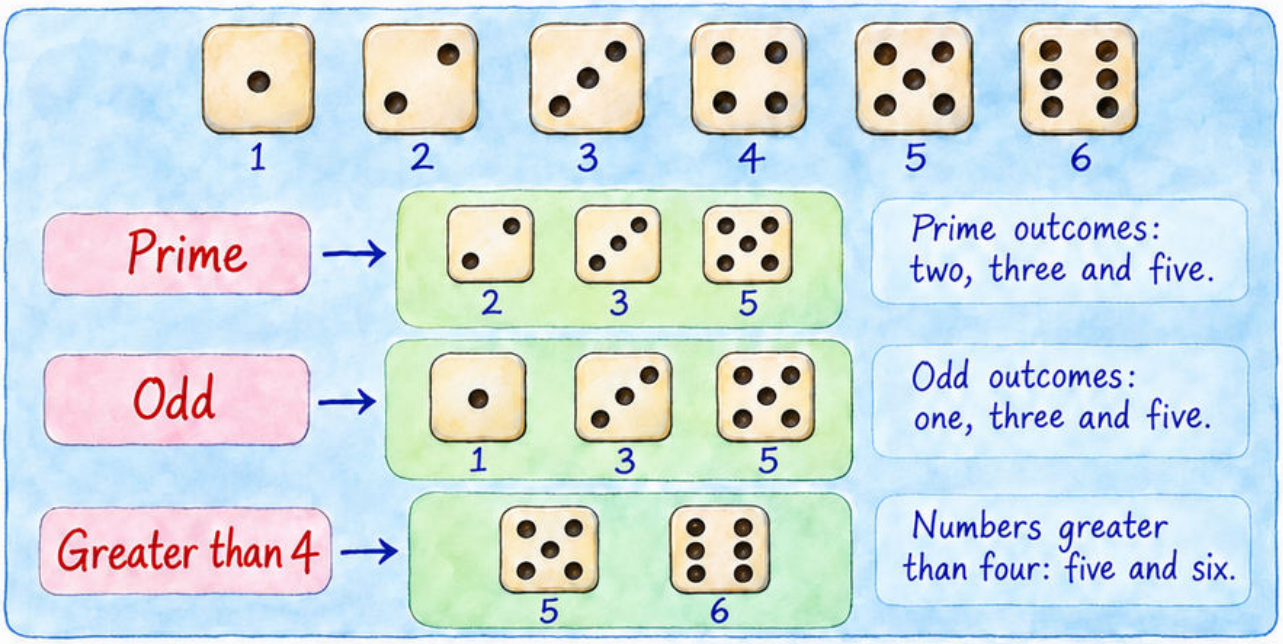
Sources: Day 29 Source Index | Topic 289

A fair die gives six equal outcomes

Start with the six faces

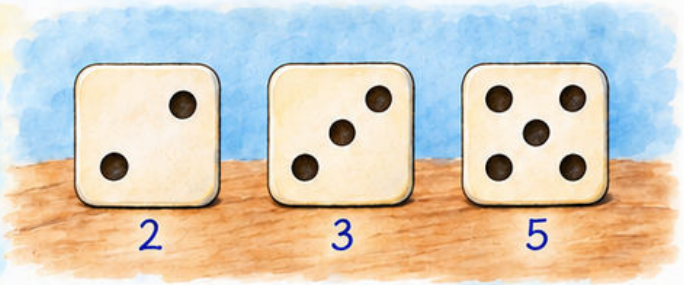
For one fair die, the sample space is 1, 2, 3, 4, 5, 6. Every face has probability 1/6. Events containing the same number of faces therefore have equal probabilities.





Prime and non-prime

The prime outcomes are two, three and five: three of six.
P(prime) = 3/6 = 1/2 = 0.5 = 50 per cent.
The complement has probability 1 − 1/2 = 1/2.
One is not a prime number.



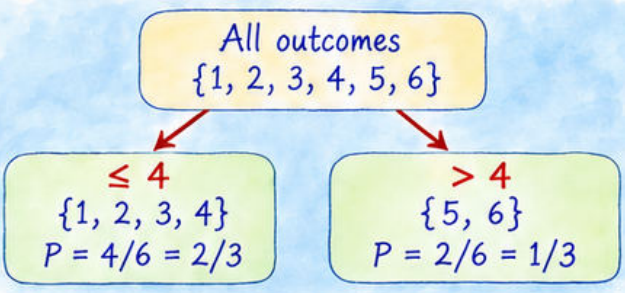
Odd numbers

The odd outcomes are one, three and five, again three of six, so P(odd) = 1/2.
Prime and odd happen to have the same probability here, but they are different events with different favourable lists.



Above or at most four

Numbers greater than four are five and six, giving 2/6 = 1/3.
Numbers less than or equal to four are one through four, giving 4/6 = 2/3.
These two events partition all outcomes, so their probabilities add to one.



Sources: Day 29 Source Index | Topic 289

Two coins make four outcomes not three

List ordered outcomes

Two fair coins produce HH, HT, TH and TT, HT means a head on the first coin and tail on the second; TH reverses them. They are distinct equally likely outcomes, so there are four, not three.



Exactly and at least one head

Exactly one head includes HT and TH, giving 2/4 = 1/2.

At least one head includes HH, HT and TH, giving 3/4.

The word at least includes the two-head result.

	Second coin H	Second coin T
First coin H	HH	HT
First coin T	TH	TT

Green cells: at least one head HH, HT and TH (3/4)

Red boxes: exactly one head: HT and TH (2/4 = 1/2)

At most and no head

At most one head includes HT, TH and TT, giving 3/4.

No head is TT alone, giving 1/4. Two tails is the same TT event and has probability 1/4 = 25 per cent.

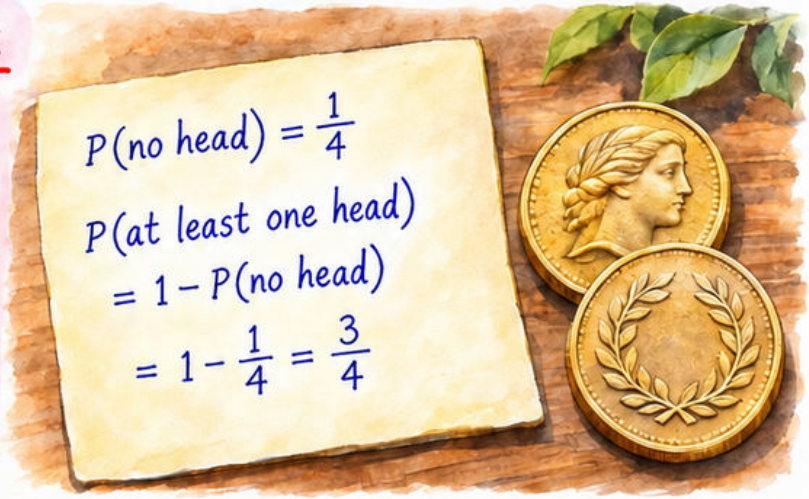
	Second coin H	Second coin T
First coin H	HH	HT
First coin T	TH	TT

At most one head: HT, TH and TT (3/4)

No head: TT alone (1/4)

Use the complement

At least one head is 1 − P(no head) = 1 − 1/4 = 3/4. At least one tail includes HT, TH and TT, also 3/4; alternatively subtract P(two heads) from one. Equal numerical answers do not make differently worded events identical.



Sources: Day 29 Source Index | Topic 289

Two dice require ordered pairs

Thirty-six outcomes

Two fair dice give $6 \times 6 = 36$ ordered outcomes, from (1,1) to (6,6). Pairs such as (2,6) and (6,2) are different because they refer to distinguishable dice.



Sum of seven

The favourable pairs are (1,6), (2,5), (3,4), (4,3), (5,2) and (6,1). Thus $P(\text{sum seven}) = \frac{6}{36} = \frac{1}{6} = 16\frac{2}{3}$ per cent.

Sum of ten

The favourable pairs are (4,6), (5,5) and (6,4). Therefore $P(\text{sum ten}) = \frac{3}{36} = \frac{1}{12}$. Different sums are not equally likely because they contain different numbers of pairs.

(i, j)	1	2	3	4	5	6
1	(1,1)	(1,2)	(1,3)	(1,4)	(1,5)	(1,6)
2	(2,1)	(2,2)	(2,3)	(2,4)	(2,5)	(2,6)
3	(3,1)	(3,2)	(3,3)	(3,4)	(3,5)	(3,6)
4	(4,1)	(4,2)	(4,3)	(4,4)	(4,5)	(4,6)
5	(5,1)	(5,2)	(5,3)	(5,4)	(5,5)	(5,6)
6	(6,1)	(6,2)	(6,3)	(6,4)	(6,5)	(6,6)

Sum of seven (6 pairs)

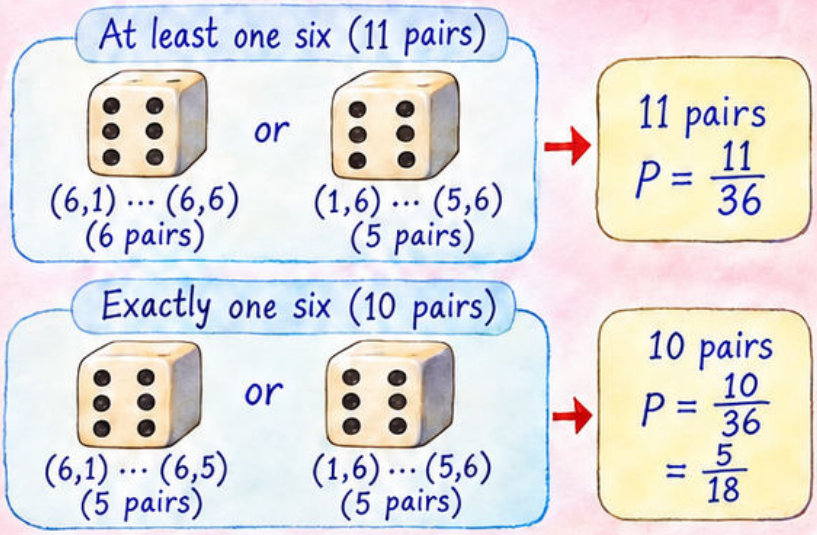
Sum of ten (3 pairs)

At least one six (11 pairs: last row or last column)

Exactly one six (10 pairs: exclude (6,6))

At least versus exactly one six

At least one six has eleven favourable pairs, including (6,6), so its probability is $\frac{11}{36}$. Exactly one six excludes that double-six outcome and has ten pairs: $\frac{10}{36} = \frac{5}{18}$. Listing the pairs prevents counting (6,6) twice or accidentally retaining it in the exactly-one event.



Sources: Day 29 Source Index | Topic 289

Know the fifty-two-card pack

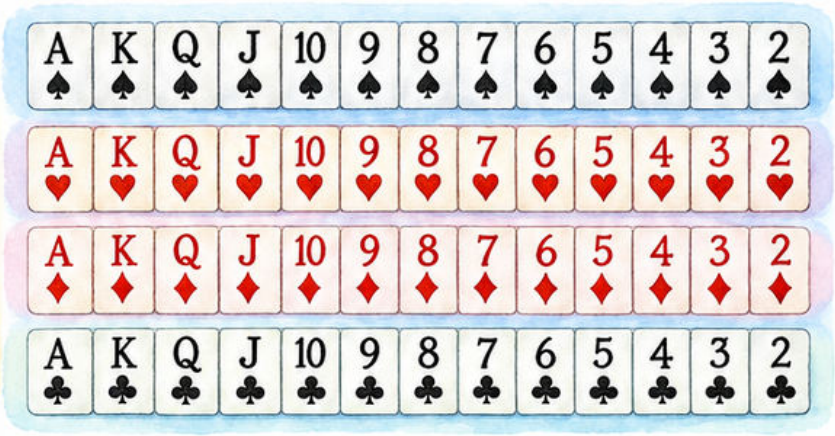
Four suits

A standard pack has fifty-two cards, thirteen each in spades, hearts, diamonds and clubs. Spades and clubs are black; hearts and diamonds are red. Each colour therefore has twenty-six cards.



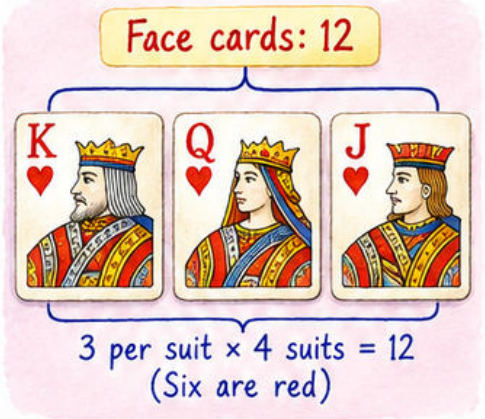
Ranks in every suit

Each suit contains ace, king, queen, jack, ten, nine, eight, seven, six, five, four, three and two. The number cards from two through ten total nine per suit, or thirty-six in the pack.



Face cards and aces

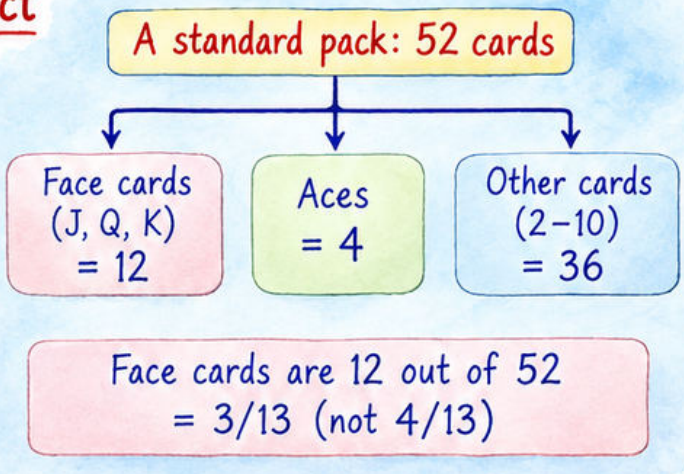
Only kings, queens and jacks count as face cards: three in each suit, twelve altogether. Six face cards are red. There are four aces, one per suit, but aces are not face cards.





Keep the denominator correct

A well-shuffled complete pack gives fifty-two equally likely single-card outcomes. The total changes only when the question specifies removed cards or a different pack. Adding aces to the face cards incorrectly gives sixteen and the wrong probability 4/13 instead of 3/13. Know the composition before applying the fraction formula.



Sources: Day 29 Source Index | Topic 289

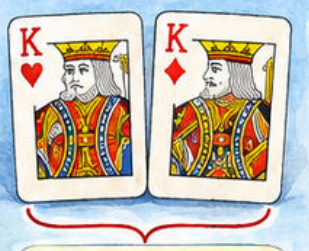
Single-card probabilities from the pack

Face card and red king

P(face card) = 12/52 = 3/13. Two kings are red, one in hearts and one in diamonds, so P(red king) = 2/52 = 1/26. Count the requested intersection, not all red cards or all kings.



Face cards: 12 of 52
(P = 12/52 = 3/13)



Red kings: 2 of 52
(P = 2/52 = 1/26)

One suit

There are thirteen spades, so P(spade) = 13/52 = 1/4. Each of the other suits has the same size and therefore the same single-draw probability in a complete shuffled pack.



Spades: 13 of 52
(P = 13/52 = 1/4)

Ace and its complement

P(ace) = 4/52 = 1/13. The forty-eight non-aces give P(not an ace) = 48/52 = 12/13. The same result follows from 1 − 1/13.



Aces: 4 of 52
(P = 4/52 = 1/13)

Numbered hearts

Hearts numbered two through ten are nine distinct cards. Their probability is 9/52, already in lowest terms. The ace is excluded by the stated range. These are single-draw calculations; drawing several cards, with or without replacement, requires attention to how the sample space changes.



Numbered hearts: 9 of 52
(P = 9/52)

Face cards	Red kings	Spades	Aces	Numbered hearts (two to ten)
				
$\frac{12}{52}$	$\frac{2}{52}$	$\frac{13}{52}$	$\frac{4}{52}$	$\frac{9}{52}$

Sources: Day 29 Source Index | Topic 289

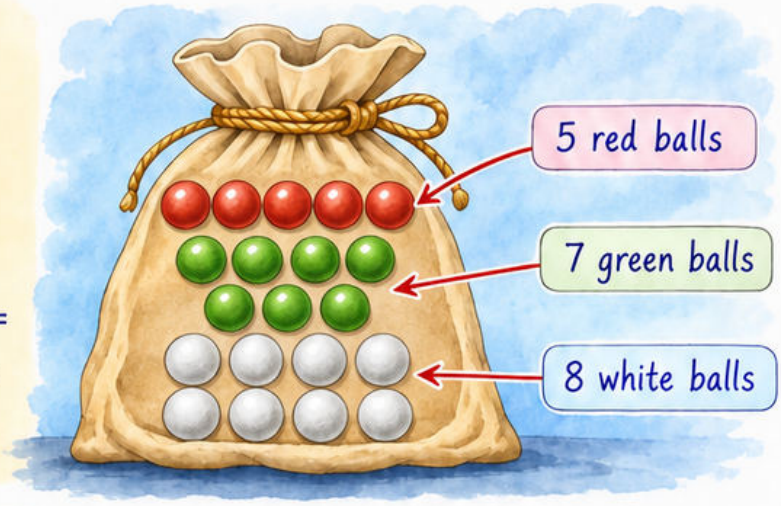
Balls and alternative number forms

A twenty-ball bag

With five red, seven green and eight white balls, P(green) = $\frac{7}{20}$ = 0.35 = 35 per cent.

P(not white) = (5 + 7)/20 = 12/20 = 3/5 = 60 per cent.

P(red) = 5/20 = 1/4.



Two more single draws

With three blue, two white and four red marbles, P(white) = $\frac{2}{9}$.

In another bag with six blue, nine yellow and five black balls, P(not yellow) = $\frac{11}{20}$ = 0.55 = 55 per cent.

Check: $\frac{9}{20} + \frac{11}{20} = 1$.



3 blue, 2 white and 4 red marbles

6 blue, 9 yellow and 5 black balls

Useful conversions

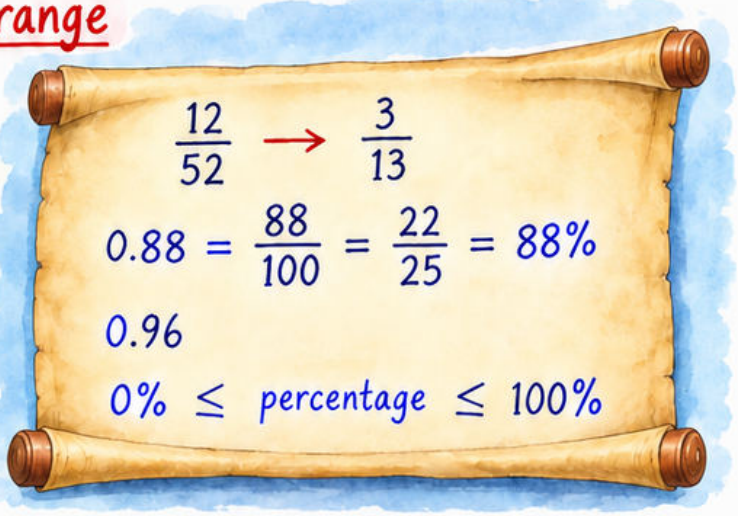
$\frac{1}{2}$ = 0.5 = 50%	$\frac{1}{4}$ = 0.25 = 25%	$\frac{3}{4}$ = 0.75 = 75%	$\frac{1}{6}$ = 0.1666... = $16\frac{2}{3}$%	$\frac{3}{8}$ = 0.375 = $37\frac{1}{2}$%	$\frac{7}{20}$ = 0.35 = 35%

Simplify and check the range

Reduce first, as in $\frac{12}{52} = \frac{3}{13}$.

A decimal such as 0.88 equals $\frac{88}{100} = \frac{22}{25}$ = 88%; 0.96 is another valid probability.

Percentages must lie between zero and one hundred. Every answer must retain the same value in fraction, decimal and percentage form.



Sources: Day 29 Source Index | Topic 289

Andhra Pradesh shifts towards population management

Why the direction is changing

Andhra Pradesh's proposed Population Management Policy seeks to encourage births because fertility is below replacement and the population is ageing. The State links fewer young workers to possible slower economic growth.



What TFR measures

Total fertility rate is the average number of children a woman is expected to have during her reproductive years under the prevailing fertility pattern. The replacement benchmark used here is 2.1. Persistently lower fertility reduces generational replacement in the long run; it does not by itself mean an immediate population fall.



Total Fertility Rate (TFR) = average number of children per woman

Replacement benchmark = 2.1



Younger (more workers) → Working-age (workforce) → Older (ageing population)

The State's population base

The 2011 Census recast for present Andhra Pradesh gives 4,95,77,103 people and density of 304 persons per square kilometre. Fertility, age structure and density describe different demographic features.

Andhra Pradesh
(2011 Census recast)

Population : 4,95,77,103 (people)

Density : 304 (persons per sq. km)



Below average versus below replacement

India's NFHS-6 TFR is 2.0, already below 2.1. Andhra Pradesh's 1.8 is both below the national figure and below replacement. Those are two separate comparisons. Do not treat the national average as if it defined the replacement threshold.

AP TFR = 1.8 < India TFR = 2.0 < Replacement TFR = 2.1

- AP TFR = 1.8 → Andhra Pradesh (1.8): below the national figure and below replacement.
- India TFR = 2.0 → India (2.0): below 2.1 (replacement).
- Replacement TFR = 2.1 → Replacement benchmark: 2.1.

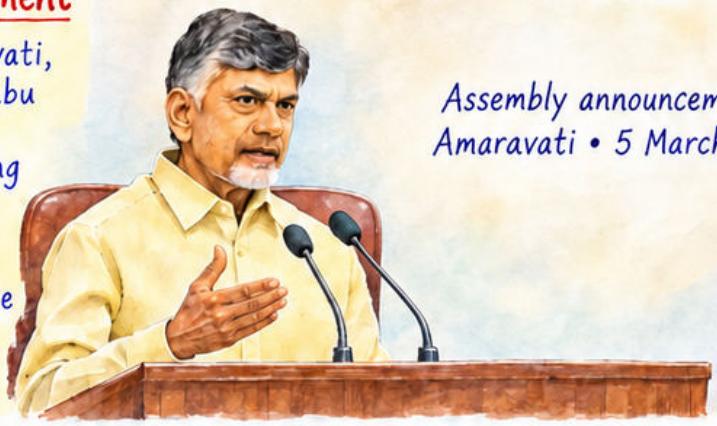
Sources: Day 29 Source Index | Topic 290

March 2026 brings a draft and consultation

The Assembly announcement

On 5 March 2026 in Amaravati, Chief Minister N. Chandrababu Naidu said a Population Management Policy was being prepared and called it the country's first such policy.

AIR reported an aim to finalise it by month-end and start implementation on 1 April.

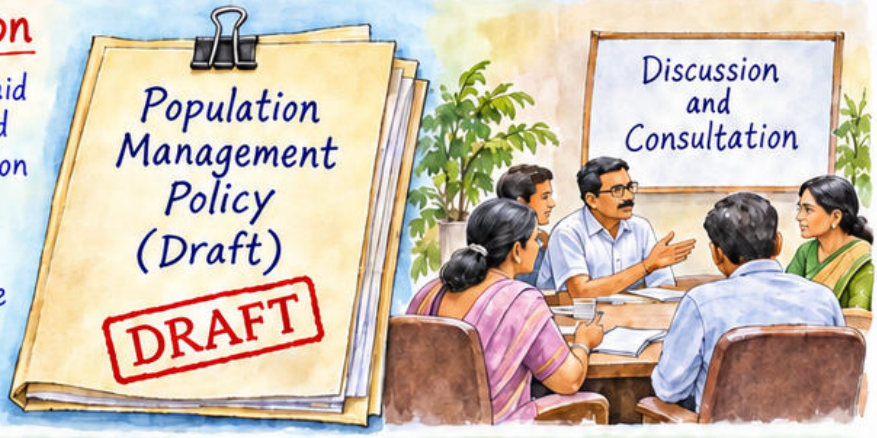


Assembly announcement • Amaravati • 5 March 2026

A draft for discussion

A report dated 6 March said the draft had been released with one month for discussion and consultation.

A proposed start date in a speech is not proof that the final policy commenced on that date.



5 March 2026 — Assembly announcement (Amaravati)

→ **6 March 2026** — Draft released for discussion and consultation

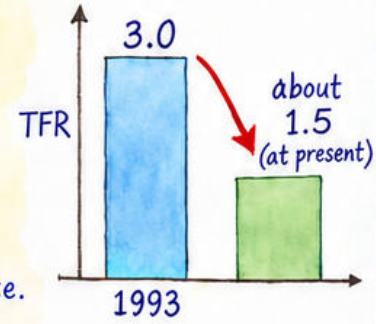
→ **One month** for discussion and consultation

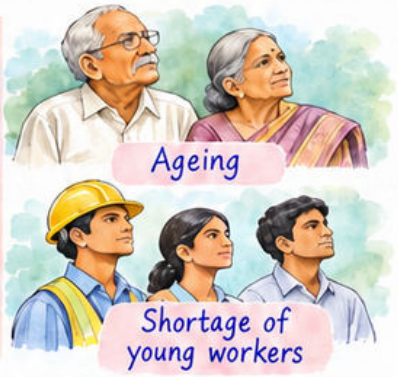
→ **1 April** — Proposed start date (intention, not confirmed commencement)

The fertility warning

The Chief Minister cited a fall from TFR 3.0 in 1993 to about 1.5 at present, warning of ageing and a shortage of young workers.

The reports did not identify the statistical base for the 1.5 estimate.

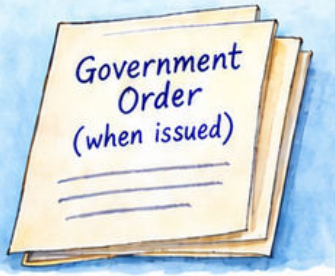




Status must remain qualified

As reported up to 1 November 2026, the material describes a draft and announced incentives. Final eligibility and implementation depend on the Government Order when issued.

Preserve announcement dates and their reported status rather than presenting every proposal as an operational entitlement.



Sources: Day 29 Source Index | Topic 290

Draft benefits extend beyond a birth payment

Reported support for larger families

The March 2026 draft was reported to propose Rs 25,000 at delivery for a third child or more, plus Rs 1,000 a month for the first five years. These are draft terms, not verified final entitlements.



Proposed: Rs 25,000 at delivery (for a third child or more)

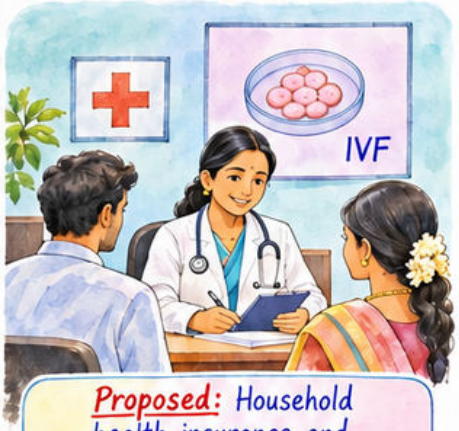
Proposed: Rs 1,000 a month (for the first five years)

Education and health

The reported package includes free education in government schools up to eighteen years, household health insurance and support for IVF, in vitro fertilisation. The measures combine initial financial support with longer-term services.



Proposed: Free education in government schools (up to eighteen years)



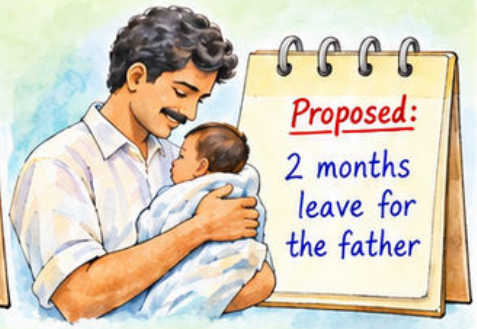
Proposed: Household health insurance and support for IVF (in vitro fertilisation)

Leave for parents

The draft proposes twelve months of maternity leave and two months of leave for the father. These are distinct proposed durations and should not be collapsed into one generic parental-leave figure.



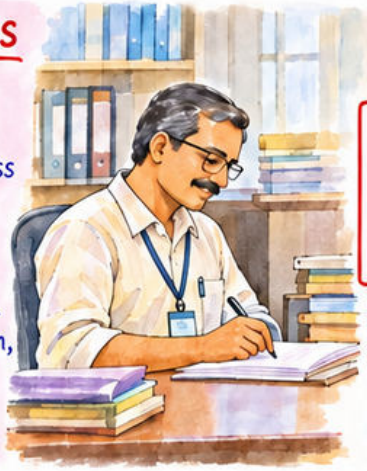
Proposed: 12 months maternity leave



Proposed: 2 months leave for the father

Government employees

Employees with three or more children were reported to be eligible for fifteen days of wellness leave before retirement and a Rs 50,000 wellness fund. One report also says the Government plans to end sterilisation incentives. Until a final order settles the design, each measure should retain the label proposed or reported.



Proposed: 15 days wellness leave (before retirement)



Proposed: Rs 50,000 wellness fund



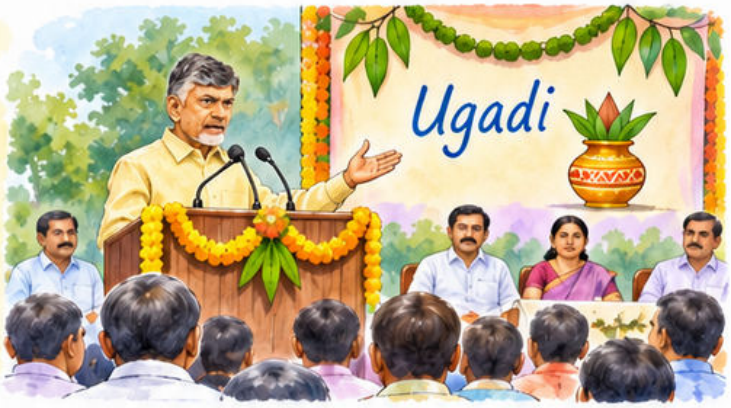
Reported: The Government plans to end sterilisation incentives.

Sources: Day 29 Source Index | Topic 290

Ugadi and May speeches announce different amounts

Ugadi in Vijayawada

At the Government's Ugadi event in March 2026, the Chief Minister announced Rs 25,000 for families with two or three children. The report dated 20 March quoted: "one is not enough, two are good and three are even better".



Narsannapeta announcement

At a public meeting in Srikakulam district on 16 May 2026, he announced Rs 30,000 immediately after the birth of a third child and Rs 40,000 for a fourth child. Reports on 16 and 17 May said details would follow within a month.



The Rs 25,000 eligibility differs

Two reports connect the draft payment with a third child or more; another describes a proposed second-child payment; the Ugadi speech refers to families with two or three. These accounts should not be combined into invented final eligibility.



Match amount to occasion

March draft
Rs 25,000
(draft payment, with eligibility referred to in reports)

→

Ugadi speech
Rs 25,000
(for families with two or three children)

→

May announcement
Rs 30,000 (immediately after the birth of a third child)
Rs 40,000 (for a fourth child)

Remember March draft, March Ugadi speech and May announcement separately. A later speech can change a proposed amount without establishing that every earlier benefit was withdrawn, merged or implemented. A Government Order, not reconciliation by guesswork, must settle the final scheme.



Sources: Day 29 Source Index | Topic 290

Local elections and Pillale Sampada

The earlier two-child bar

The undivided State introduced a two-child restriction for local-body candidates in 1994. On 18 November 2024, the Assembly passed the Andhra Pradesh Panchayat Raj (Amendment) Bill and Andhra Pradesh Municipal Laws (Amendment) Bill to remove it.

1994
Two-child restriction for local-body candidates

18 November 2024
Assembly passed the Andhra Pradesh Panchayat Raj (Amendment) Bill and Andhra Pradesh Municipal Laws (Amendment) Bill to remove it.



What removal means

The reported change allows people with more than two children to contest Panchayat and urban local-body elections. Electoral eligibility reform is a different measure from a cash incentive for childbirth.


People with more than two children

Can contest Panchayat and urban local-body elections

World Population Day, 11 July 2026

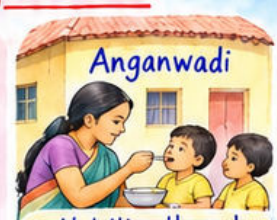
In Vijayawada, the Chief Minister launched "Pillale Sampada", meaning Children are Wealth, describing a shift from population control to population conservation. He said public consultation would precede implementation of the new policy.

Pillale Sampada
(Children are Wealth)
From population control
↓
to population conservation



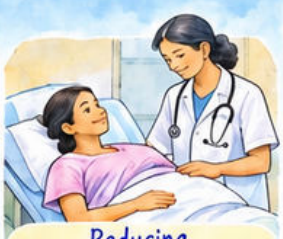
Services and an existing scheme

The initiative highlights nutrition through Anganwadi centres, workplace childcare and reducing unnecessary Caesarean deliveries. AIR's report also described the existing Talliki Vandanam education support of Rs 15,000 per child. Keep that existing scheme separate from the proposed birth incentives and do not present the July launch as proof of final notification of every draft term.



Nutrition through Anganwadi centres


Workplace childcare


Reducing unnecessary Caesarean deliveries



Talliki Vandanam
Education support of Rs 15,000 per child (existing scheme)



Sources: Day 29 Source Index | Topic 290

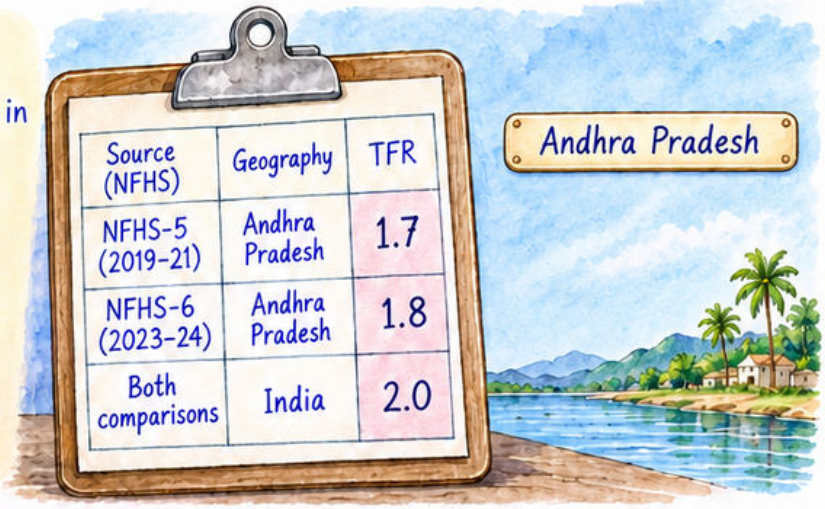
Fertility numbers need survey labels

NFHS-5 and NFHS-6

Andhra Pradesh's TFR was 1.7 in NFHS-5, 2019-21, and 1.8 in NFHS-6, 2023-24. India was 2.0 in both comparisons, as reported in the 24 July 2026 Lok Sabha answer.

The later State estimate is slightly higher, but remains below replacement.

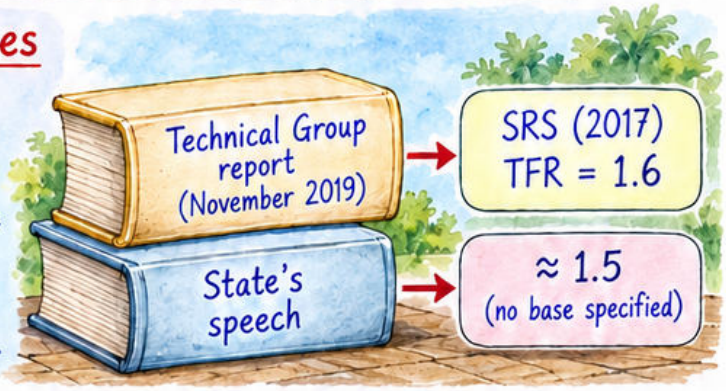
Source (NFHS)	Geography	TFR
NFHS-5 (2019-21)	Andhra Pradesh	1.7
NFHS-6 (2023-24)	Andhra Pradesh	1.8
Both comparisons	India	2.0



Other bases give other values

The Technical Group's November 2019 report gives an SRS TFR of 1.6 for 2017. The State's speech figure of about 1.5 has no base specified in the reports.

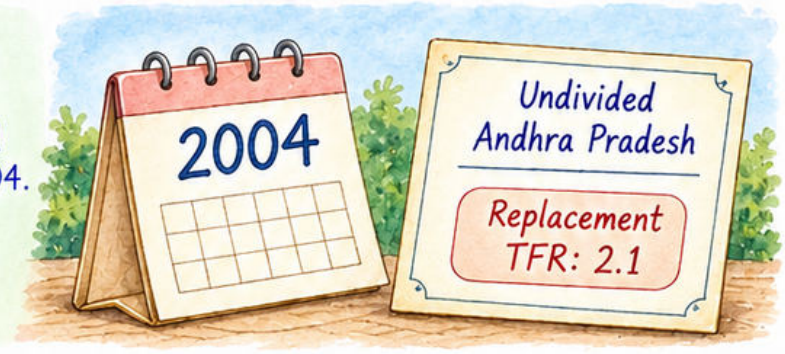
Neither should replace a survey-round answer when the question names NFHS.



The earlier milestone

The Technical Group reports that undivided Andhra Pradesh reached the replacement TFR of 2.1 in 2004.

That historical State boundary differs from the present-State NFHS comparison.



The regional contrast

NFHS-6 figures are Tamil Nadu 1.7, Kerala 1.8, Karnataka 1.8 and Telangana 1.9, compared with Uttar Pradesh 2.2 and Bihar 2.7.

The listed southern States are below 2.1; Uttar Pradesh and Bihar are above it.

Match each number to its geography, year and source.

NFHS-6 (2023-24): TFR by State

Tamil Nadu	1.7
Kerala	1.8
Karnataka	1.8
Telangana	1.9
Uttar Pradesh	2.2
Bihar	2.7

Replacement benchmark: 2.1

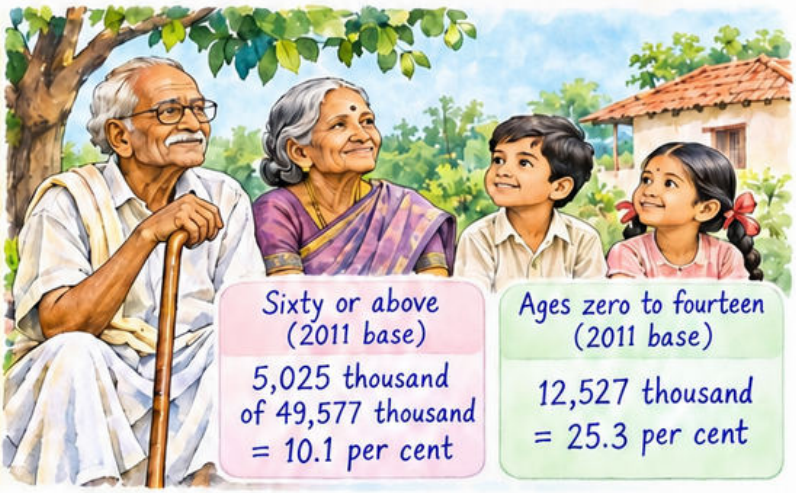
Sources: Day 29 Source Index | Topic 290

An ageing State needs more than one indicator

The 2011 age base

The Technical Group's base table gives 5,025 thousand people aged sixty or above out of 49,577 thousand total, about 10.1 per cent.

Ages zero to fourteen numbered 12,527 thousand, about 25.3 per cent.



Sixty or above (2011 base)	Ages zero to fourteen (2011 base)
5,025 thousand of 49,577 thousand = 10.1 per cent	12,527 thousand = 25.3 per cent

The State projection

The draft's reported projection puts the sixty-plus share at about 23 per cent by 2047, compared with about 10 per cent now. This is a State projection, not the same thing as the exact 2011 base calculation.

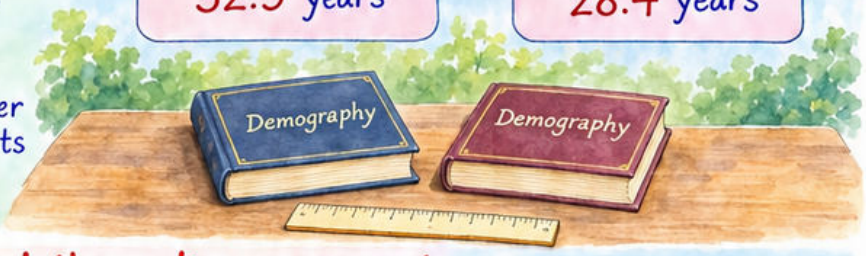
Now (reported)	State projection (2047)
Sixty-plus share about 10 per cent	Sixty-plus share about 23 per cent



Median age

Reported State Health Department figures put Andhra Pradesh's median age at 32.5 years, compared with India's 28.4. Median age and the share over sixty measure different aspects of ageing.

Andhra Pradesh (median age)	India (median age)
32.5 years	28.4 years



Ageing elsewhere and the policy argument

The Technical Group's projections for 2011-36 put Kerala's sixty-plus share rising from 13 to 23 per cent and Uttar Pradesh's from seven to twelve per cent.

Andhra Pradesh argues that fewer young workers can slow growth.

In May 2026, Health Secretary Sourabh Gaur called for enabling and incentivising families to have children.



Kerala (2011-36)	13 per cent →	23 per cent



Uttar Pradesh (2011-36)	seven per cent →	twelve per cent



Sources: Day 29 Source Index | Topic 290

The national policy had a different direction

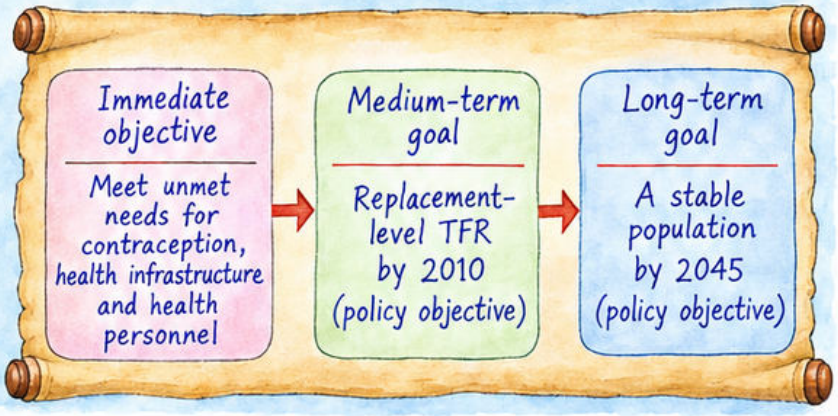
National Population Policy, 2000

The national policy promoted the small-family norm. Its immediate objective was to meet unmet needs for contraception, health infrastructure and health personnel.



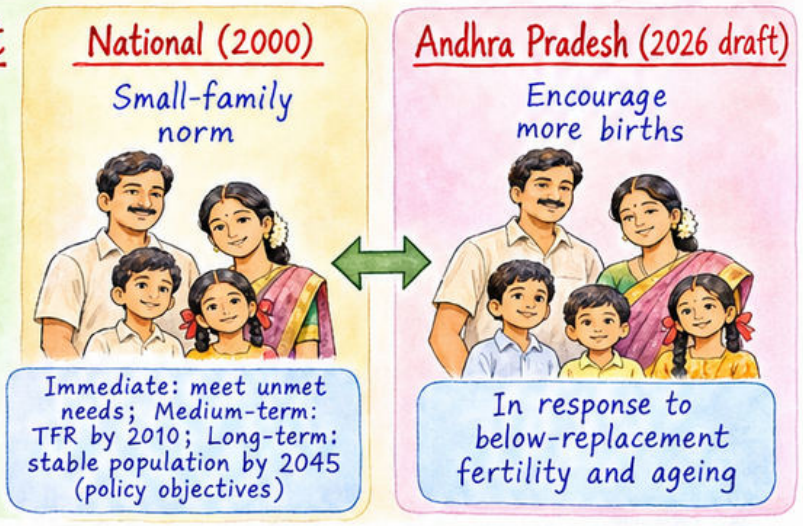
Medium and long term

Its medium-term goal was replacement-level TFR by 2010. Its long-term goal was a stable population by 2045. These dates are policy objectives, not automatic statements that the outcomes were achieved.



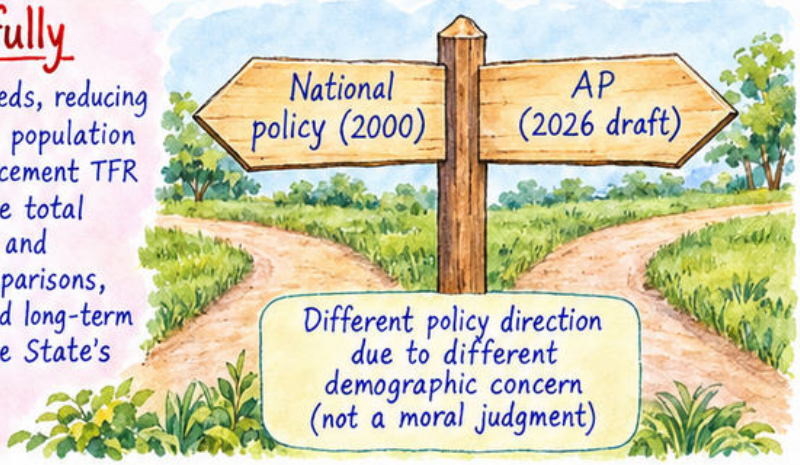
The Andhra Pradesh contrast

The State's proposed approach encourages more births in response to below-replacement fertility and ageing. The policy direction differs because its stated demographic concern differs from the earlier national emphasis.



Read the objectives carefully

Meeting unmet reproductive-health needs, reducing fertility to replacement and stabilising population are related but separate goals. A replacement TFR is a fertility measure, whereas a stable total population also reflects age structure and demographic change over time. For comparisons, identify the immediate, medium-term and long-term national objectives, then distinguish the State's reported pronatalist proposals.

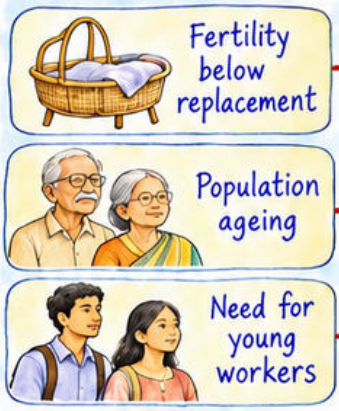


Sources: Day 29 Source Index | Topic 290

Reproductive choice and the economic debate

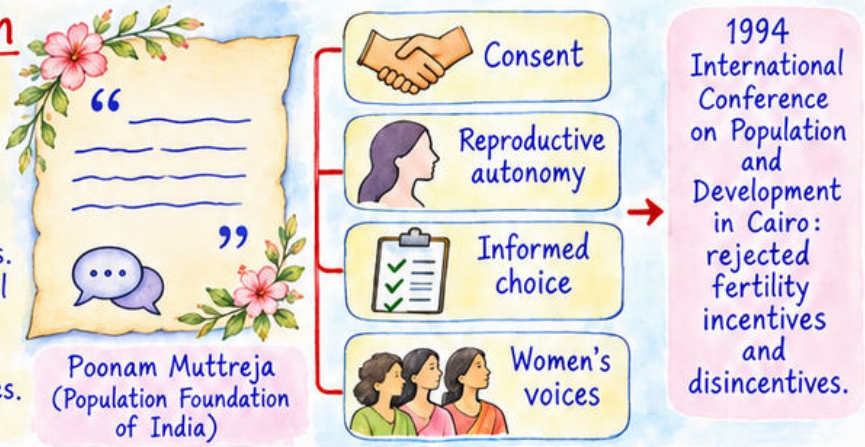
The State's case

The Government cites fertility below replacement, population ageing and the need for young workers. Its proposed incentives seek to enable families to have more children rather than continuing the earlier population-control emphasis.



Autonomy and health

Poonam Muttreja of the Population Foundation of India argued on 25 May 2026 that pronatalist policy must centre consent, reproductive autonomy, informed choice and women's voices. She recalled the 1994 International Conference on Population and Development in Cairo as rejecting fertility incentives and disincentives.



The cost of raising children

Muttreja argued that a one-time payment does not meet the continuing costs that help explain falling fertility. A 19 June 2026 commentary in The Wire argued that development comes from nurturing existing human potential rather than incentivising larger families. These are attributed positions in a policy debate.



International examples

Japan, Singapore and South Korea have tried incentives. Hungary's 2019 package included tax relief for mothers of large families and easier loans. Russia's maternal-capital subsidy can support housing or a child's education. Their existence alone does not establish that every incentive succeeds or that their designs match Andhra Pradesh's draft.



Sources: Day 29 Source Index | Topic 290