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SOLUTIONS BOOK

CLASS 9

Mathematics · Ganita Manjari

CHAPTER 7

The Mathematics of Maybe: Introduction to Probability

Complete Exercise Solutions

Exercise Set 7.1 | Exercise Set 7.2 | Exercise Set 7.3 | Exercise Set 7.4 | End-of-Chapter Exercises | In-Text Questions

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7.1

CLASS 9 MATHS · GANITA MANJARI · CHAPTER 7

Exercise Set 7.1

Solutions · 1 question

QUESTION 1

Rank the following events on a scale from 0 (Impossible) to 1 (Certain). Label each event: Impossible, less likely, equally likely (even chance), more likely, certain. Give reasons why you gave each event its ranking.

(i) The next Monday will come after Sunday.

(ii) It will snow in Mumbai in July.

(iii) An elephant will walk through your classroom today.

(iv) You will greet at least one friend at school tomorrow.

ANSWER

Probability is measured on a scale from 0 (impossible) to 1 (certain). The ranking of (iii) and (iv) is a matter of judgement based on evidence, so reasonable answers may differ slightly.

(i) The next Monday will come after Sunday — CERTAIN

In the week the day after Sunday is always Monday. There is no way this can fail to happen, so the probability is 1.

(ii) It will snow in Mumbai in July — IMPOSSIBLE

Mumbai has a hot, humid climate, and July is in the middle of its monsoon (heavy rain, temperature about 25–30 °C). Snow never falls there, so we rank it at (practically) 0.

(iii) An elephant will walk through your classroom today — IMPOSSIBLE

An elephant is too big to enter a classroom through the door, and there is no reason for one to be at school. It is not logically impossible (for example, a stuffed toy elephant could be carried in), but for a real elephant the probability is practically 0.

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(iv) You will greet at least one friend at school tomorrow MORE LIKELY

If you go to school tomorrow, you will almost certainly meet and greet at least one friend, so the event is close to 1. It is not exactly certain, because you might be absent, or it may be a holiday.

(i) Certain: probability = 1
(iv) More likely: probability close to 1 (say, 0.9)
(ii), (iii) Impossible: probability = 0 (practically)

On the scale from 0 to 1: (ii), (iii) are at 0, (iv) is close to 1, and (i) is at 1.

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7.2

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Exercise Set 7.2

Solutions · 6 questions

QUESTION 1

A teacher mixes a large bag of sweets of different colours and randomly selects a sample of 30 sweets. She counts the number of sweets of each colour:

10 red sweets | 8 green sweets | 7 yellow sweets | 5 blue sweets

(i) Calculate the probability that a randomly picked sweet from the sample is green.

(ii) If there are 600 sweets in total in the large bag, estimate how many are likely to be yellow, based on the sample results.

ANSWER

Check the sample size: 10 + 8 + 7 + 5 = 30 sweets.

(i) **Probability that a sweet from the sample is green**

P(green) = (number of green sweets) ÷ (total number of sweets in the sample)
= 8 ÷ 30 = 4/15 ≈ 0.267

(ii) **Estimate of yellow sweets in the bag of 600**

The probability of a yellow sweet from the sample is 7/30. Assuming the bag has the same mix as the sample:

Estimated number of yellow sweets = 7/30 × 600 = 7 × 20 = 140

(i) P(green) = 8/30 = 4/15 ≈ 0.267. (ii) About 140 of the 600 sweets are likely to be yellow.

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QUESTION 2

A survey is conducted at a school where a random sample of 40 students is asked about their favourite club. The responses are:

14 students: Science Club | 11 students: Arts Club | 9 students: Sports Club | 6 students: Debate Club

Assume there are 800 students in the whole school.

(i) What is the probability that a randomly chosen student from the sample prefers the Arts Club?

(ii) Using the sample results, estimate how many students in the whole school are likely to prefer the Sports Club.

ANSWER

Check the sample size: 14 + 11 + 9 + 6 = 40 students.

(i) Probability of preferring the Arts Club

$$P(\text{Arts Club}) = 11 \div 40 = 0.275$$

(ii) Estimate for the whole school

The probability of preferring the Sports Club in the sample is 9/40 = 0.225. For 800 students:

$$\text{Estimated number} = 9/40 \times 800 = 9 \times 20 = 180$$

(i) 11/40 = 0.275 (27.5%). (ii) About 180 students of the school are likely to prefer the Sports Club.

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QUESTION 3

Toss a coin 20 times and record the result each time (heads or tails).

(i) How many times did you get heads?

(ii) How many times did you get tails?

(iii) Calculate the experimental probability of getting heads.

(iv) If you toss the coin once more, what is the probability of getting tails?

ANSWER

This is an experiment, so your own results will differ. Here is one sample record of 20 tosses to show how to answer (it was produced with a random-number generator in place of a real coin):

T T H T H H H H T T H T H H H H T T H T

(i) Number of heads

Counting the H's in the record gives 11 heads.

(ii) Number of tails

The number of tails is 20 – 11 = 9.

(iii) Experimental probability of heads

Experimental probability = (number of times heads occurred) ÷ (total number of tosses)
= 11 ÷ 20 = 0.55 (for this record)

(iv) Probability of tails on one more toss

Each toss of a fair coin is independent of the earlier ones (the coin has no memory), and heads and tails are equally likely. So the earlier results do not change the probability.

P(tails) = 1/2 = 0.5 for the next toss, whatever happened before. Your experimental value in (iii) will be close to 0.5, but need not equal it.

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QUESTION 4

Toss a paper cup into the air 100 times. After each toss record whether the cup lands on its bottom, upside down on its top or on its side (See Fig. 7.5). Assign probabilities to the outcomes by using experimental probability.



Fig. 7.5: Paper cup landing positions (left to right) — bottom, top and side

ANSWER

A cup is not symmetrical like a coin, so there is no reason for the three outcomes to be equally likely; the probabilities must be found from the experiment. Tally the 100 tosses, then divide each count by 100. The numbers below are only an example of the method; your counts will be different.

Outcome	Number of times (example)	Experimental probability
Lands on its bottom	31	31 ÷ 100 = 0.31
Lands upside down on its top	17	17 ÷ 100 = 0.17
Lands on its side	52	52 ÷ 100 = 0.52
Total	100	1.00

The three experimental probabilities add up to 1, because every toss gives exactly one of the three outcomes. In general the probability of each outcome is (number of times it occurred) ÷ 100.

P(outcome) = (number of tosses with that outcome) ÷ 100, for each of ‘bottom’, ‘top’ and ‘side’; the three values add up to 1.

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QUESTION 5

What is the probability of getting an even number when rolling a fair 6-sided die?

ANSWER

Sample space: S = {1, 2, 3, 4, 5, 6}, so there are 6 equally likely outcomes

Favourable outcomes (even numbers): {2, 4, 6}, so there are 3

P(even number) = 3 ÷ 6 = 1/2

The probability of getting an even number is 1/2 = 0.5.

QUESTION 6

Suppose you roll a 6-sided die 12 times and get a '3' three times.

(i) What is the experimental probability of rolling a '3'?

(ii) What is the theoretical probability of rolling a '3'?

(iii) Why might these probabilities be different? What would you expect to happen if you roll the die 60, 600, or 6000 times?

ANSWER

(i) **Experimental probability**

3 ÷ 12 = 1/4 = 0.25

(ii) **Theoretical probability**

One favourable outcome (3) out of 6 equally likely outcomes: 1/6 ≈ 0.167

(iii) **Why they differ**

The experimental probability is based on what actually happened in only 12 rolls, and with so few trials chance fluctuations are large (a 3 coming up 3 times instead of the 2 times that 1/6 predicts). The theoretical probability describes the ideal fair die.

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If the die is rolled 60, 600 or 6000 times, we expect about 1/6 of the rolls to be a 3, i.e. about 10, 100 and 1000 threes respectively. The experimental probability will not be exactly 1/6 each time, but as the number of trials increases it tends to get closer and closer to the theoretical value 1/6 ≈ 0.167 (the Law of Large Numbers).

(i) 1/4 = 0.25 (ii) 1/6 ≈ 0.167 (iii) With few trials, chance can make them differ; with more and more trials the experimental probability gets close to 1/6.

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7.3

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Exercise Set 7.3

Solutions · 3 questions

QUESTION 1

When a single 6-sided die is rolled, what is the total number of possible outcomes in the sample space?

ANSWER

The top face can show any one of 1, 2, 3, 4, 5, 6.

$S = \{1, 2, 3, 4, 5, 6\}, n(S) = 6$

There are 6 possible outcomes in the sample space.

QUESTION 2

For the following experiments write down the sample space S.

(i) Rolling a die and tossing a coin together.

(ii) Choosing a random integer between – 5 and + 5.

(iii) A box containing 5 green and 7 red balls. One ball is drawn at random.

ANSWER

(i) Rolling a die and tossing a coin together

Each of the 6 faces can be paired with heads or tails, so there are $6 \times 2 = 12$ outcomes:

$S = \{1H, 1T, 2H, 2T, 3H, 3T, 4H, 4T, 5H, 5T, 6H, 6T\}, n(S) = 12$

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(ii) A random integer between – 5 and + 5

Taking 'between' to mean strictly between (– 5 and + 5 are not included), the integers are:

$S = \{-4, -3, -2, -1, 0, 1, 2, 3, 4\}$, $n(S) = 9$

(If – 5 and + 5 are also allowed, then $S = \{-5, -4, \ldots, 4, 5\}$ and $n(S) = 11$.)

(iii) A box with 5 green and 7 red balls; one ball drawn

If we only record the colour of the ball drawn:

$S = \{\text{Green, Red}\}$, $n(S) = 2$

These two outcomes are not equally likely (7 balls are red and only 5 green). If we want equally likely outcomes, we may name the balls G1, ..., G5, R1, ..., R7:

$S = \{G1, G2, G3, G4, G5, R1, R2, R3, R4, R5, R6, R7\}$, $n(S) = 12$

The sample spaces are as listed above; the level of detail should suit the question being studied.

QUESTION 3

In a village fair, there are 3 popular snacks available: Samosa, Pakora, and Bhaji. For drinks, villagers can choose either Chai or Lassi.

(i) List the sample space of all possible snack and drink combinations a person could choose at the fair.

(ii) List the event 'Selecting Samosa as a snack.'

ANSWER

(i) Sample space of snack and drink combinations

Each of the 3 snacks can be combined with each of the 2 drinks, so there are $3 \times 2 = 6$ combinations:

$S = \{(\text{Samosa, Chai}), (\text{Samosa, Lassi}), (\text{Pakora, Chai}), (\text{Pakora, Lassi}), (\text{Bhaji, Chai}), (\text{Bhaji, Lassi})\}$

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(ii) **The event ‘Selecting Samosa as a snack’**

The event consists of all outcomes in which the snack is Samosa:

$$E = \{(\text{Samosa, Chai}), (\text{Samosa, Lassi})\}$$

n(S) = 6 and the event E has 2 elements; E is a subset of S.

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7.4

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Exercise Set 7.4

Solutions · 2 questions

QUESTION 1

There are two fruit baskets A and B. Basket A has one apple and two oranges. Basket B has one banana and one mango. You randomly pick one fruit from each basket.

(i) Draw a tree diagram showing all possible pairs of fruits.

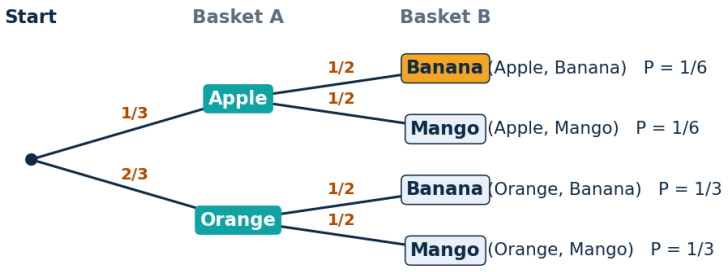
(ii) List the sample space.

(iii) What is the probability of picking one apple and one banana?

ANSWER

(i) Tree diagram

Basket A has 3 fruits: P(apple) = 1/3 and P(orange) = 2/3. Basket B has 2 fruits: P(banana) = P(mango) = 1/2. The probability of a pair is the product of the probabilities along its path.



Tree diagram for picking one fruit from each basket

(ii) Sample space

S = {(Apple, Banana), (Apple, Mango), (Orange, Banana), (Orange, Mango)}

These four pairs are not equally likely, because Basket A has two oranges. If the two oranges are named O_1 and O_2, the sample space has 6 equally likely pairs: (Apple, Banana), (Apple, Mango), (O_1, Banana), (O_1, Mango), (O_2, Banana), (O_2, Mango).

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(iii) Probability of one apple and one banana

P(Apple, Banana) = P(Apple) × P(Banana) = 1/3 × 1/2 = 1/6

Check with the 6 equally likely pairs: 1 favourable pair out of 6 = 1/6

P(one apple and one banana) = 1/6 ≈ 0.167.

QUESTION 2

Let us say that you have a box containing 3 red pens, 4 black pens and 2 green pens. You pick a pen (without looking) from the box and put it back. Then your friend does the same.

(i) What are the possible outcomes of the pen colours? Can you draw a tree diagram representing the possible outcomes?

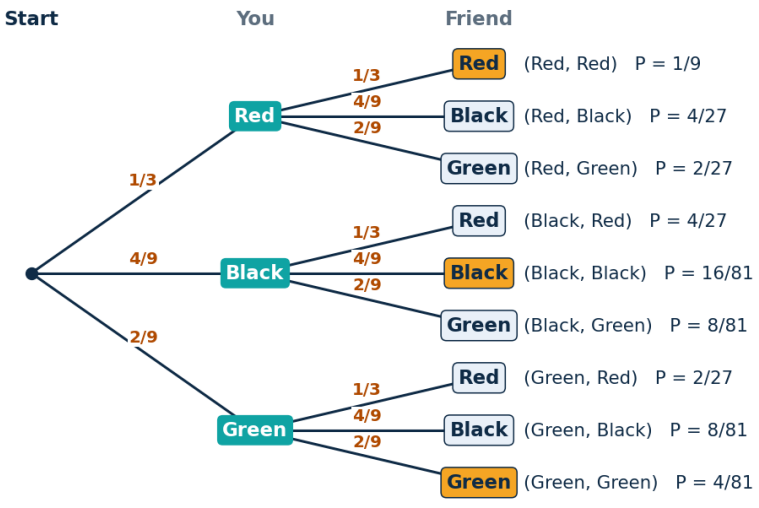
(ii) Can you use the tree diagram to guess the probability that both you and your friend pick pens of the same colour?

ANSWER

(i) Possible outcomes and the tree diagram

There are 9 pens: P(red) = 3/9 = 1/3, P(black) = 4/9, P(green) = 2/9. Since the pen is put back, the same probabilities apply for your friend. The possible outcomes (you, friend) are the 9 colour pairs:

S = {RR, RB, RG, BR, BB, BG, GR, GB, GG} (R = red, B = black, G = green)



Tree diagram (the highlighted outcomes are those with the same colour)

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(ii) Probability of the same colour

The outcomes with the same colour are RR, BB, GG:

$P(RR) = 3/9 \times 3/9 = 9/81$

$P(BB) = 4/9 \times 4/9 = 16/81$

$P(GG) = 2/9 \times 2/9 = 4/81$

$P(\text{same colour}) = (9 + 16 + 4) \div 81 = 29/81 \approx 0.358$

The probability that both pick pens of the same colour is 29/81 ≈ 0.36 (about 36%).

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EOC

CLASS 9 MATHS · GANITA MANJARI · CHAPTER 7

End-of-Chapter Exercises

Solutions · 16 questions

QUESTION 1

Fill in the blanks.

(i) The probability of an impossible event is _____.

(ii) The set of all possible outcomes of a random experiment is called the _____.

(iii) The probability of an event that is certain to happen is _____.

(iv) Tossing a fair coin has a probability of _____ for getting heads.

ANSWER

(i) The probability of an impossible event is **0**.
(ii) The set of all possible outcomes of a random experiment is called the **sample space**.
(iii) The probability of an event that is certain to happen is **1**.
(iv) Tossing a fair coin has a probability of **1/2** (0.5) for getting heads.

(i) 0 (ii) sample space (iii) 1 (iv) 1/2

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QUESTION 2

In a survey of 50 students, 15 students said they liked football. The number of students who like football is 15, and the _____ (frequency/relative frequency) is _____ (fill in the fraction or decimal).

ANSWER

The number of times something occurs (15 students) is its frequency. The frequency divided by the total number of observations is the relative frequency.

$$\text{Relative frequency} = 15 \div 50 = 3/10 = 0.3$$

The relative frequency is 3/10 = 0.3.

QUESTION 3

Which of the following experiments have equally likely outcomes? Explain.

(i) A driver attempts to start a car. The car starts or does not start.

(ii) Tossing a fair coin once.

(iii) Rolling a fair 6-sided die.

(iv) Choosing a marble randomly from a bag that contains 3 red marbles and 7 blue marbles.

(v) A baby is born. It is a boy or a girl.

ANSWER

(i) Car starts or does not start — NOT EQUALLY LIKELY

A working car starts most of the time, so ‘starts’ is much more likely than ‘does not start’ (there is a reason for one outcome to be more likely than the other).

(ii) Tossing a fair coin once — EQUALLY LIKELY

The coin is fair (symmetrical), so heads and tails each have probability 1/2.

(iii) Rolling a fair 6-sided die — EQUALLY LIKELY

A fair die is symmetrical, so each of the faces 1 to 6 has probability 1/6.

(iv) A marble from 3 red and 7 blue — NOT EQUALLY LIKELY

The colours are not equally likely: P(red) = 3/10 and P(blue) = 7/10. (The 10 individual marbles are equally likely, but the two colour outcomes are not.)

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(v) **A baby is born: boy or girl** APPROX. EQUAL

There is no reason to expect one over the other, so the two outcomes are taken to be (very nearly) equally likely, each with probability about 1/2.

Equally likely: (ii), (iii) and (v) (the last one approximately). Not equally likely: (i) and (iv).

QUESTION 4

Write the sample space and calculate the probability based on the given information.

(i) Two coins are tossed at the same time. What is the probability of getting at least one head?

(ii) Ten identical cards numbered 1 to 10 are placed in a box. One card is drawn at random. What is the probability of drawing a card with an even number?

(iii) A die is rolled once. What is the probability of getting a number greater than 4?

(iv) A bag contains 3 red balls, 2 blue balls, and 1 green ball. One ball is picked at random. What is the probability that it is not red?

(v) Three coins are tossed simultaneously. What is the probability of getting exactly two heads?

ANSWER

(i) **At least one head with two coins**

S = {HH, HT, TH, TT}, n(S) = 4
E = {HH, HT, TH}, n(E) = 3
P(E) = 3/4 = 0.75

(ii) **An even number from cards 1 to 10**

S = {1, 2, 3, 4, 5, 6, 7, 8, 9, 10}, n(S) = 10
E = {2, 4, 6, 8, 10}, n(E) = 5
P(E) = 5/10 = 1/2

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(iii) **A number greater than 4 on a die**

S = {1, 2, 3, 4, 5, 6}, n(S) = 6
E = {5, 6}, n(E) = 2
P(E) = 2/6 = 1/3

(iv) **A ball that is not red**

Name the balls: S = {R_1, R_2, R_3, B_1, B_2, G}, n(S) = 6
E = {B_1, B_2, G}, n(E) = 3
P(not red) = 3/6 = 1/2 (or 1 – P(red) = 1 – 3/6 = 1/2)

(v) **Exactly two heads with three coins**

S = {HHH, HHT, HTH, HTT, THH, THT, TTH, TTT}, n(S) = 8
E = {HHT, HTH, THH}, n(E) = 3
P(E) = 3/8 = 0.375

(i) 3/4 (ii) 1/2 (iii) 1/3 (iv) 1/2 (v) 3/8

QUESTION 5

A bag has 3 candies: strawberry, lemon, and mint. One is picked at random. What is the probability of picking a strawberry candy?

ANSWER

S = {Strawberry, Lemon, Mint}, n(S) = 3 (equally likely)
E = {Strawberry}, n(E) = 1
P(strawberry) = 1/3 ≈ 0.333

The probability of picking a strawberry candy is 1/3.

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QUESTION 6

A child has 2 shirts (one red and one blue) and 3 types of pants (jeans, khakis, and shorts). List all the possible combinations of outfits consisting of one shirt and one pair of pants. Display your answer in a table format.

ANSWER

Each of the 2 shirts can be worn with each of the 3 pants, so there are $2 \times 3 = 6$ outfits.

Shirt	Pants	Outfit
Red	Jeans	Red shirt with jeans
Red	Khakis	Red shirt with khakis
Red	Shorts	Red shirt with shorts
Blue	Jeans	Blue shirt with jeans
Blue	Khakis	Blue shirt with khakis
Blue	Shorts	Blue shirt with shorts

There are 6 possible outfits, as listed in the table.

QUESTION 7

A tyre company records distances before replacement in 1000 cases.

Distance (km)	Less than 4000	4001 to 9000	9001 to 14000	More than 14000
Number of cases	20	210	325	445

Find the probability that a randomly chosen tyre lasts:

(i) Less than 4000 km.

(ii) Between 4000 and 14000 km.

(iii) More than 14000 km.

ANSWER

Check the total: 20 + 210 + 325 + 445 = 1000 cases. Each probability is (number of cases) ÷ 1000.

(i) **Less than 4000 km**

$$P = 20 \div 1000 = 0.02$$

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(ii) **Between 4000 and 14000 km**

Cases in '4001 to 9000' and '9001 to 14000' = 210 + 325 = 535
P = 535 ÷ 1000 = 0.535

(iii) **More than 14000 km**

P = 445 ÷ 1000 = 0.445

(i) 0.02 (ii) 0.535 (iii) 0.445. (Check: 0.02 + 0.535 + 0.445 = 1.)

QUESTION 8

The letters of the word 'PEACE' are placed on cards. Leela draws a card without looking.

Cards: P | E | A | C | E

(i) What is the probability that it is a P, E or C?

(ii) What is the probability that it is not an E?

ANSWER

There are 5 cards, each equally likely to be drawn: P, E, A, C, E.

(i) **A P, E or C**

Favourable cards: P (1 card), E (2 cards), C (1 card) = 4 cards
P(P, E or C) = 4/5 = 0.8

(ii) **Not an E**

Cards that are not E: P, A, C = 3 cards
P(not E) = 3/5 = 0.6 (or 1 – P(E) = 1 – 2/5 = 3/5)

(i) 4/5 (ii) 3/5

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QUESTION 9 *

A game of chance consists of spinning an arrow (see Fig. 7.7.) which comes to rest pointing at one of the numbers 1, 2, 3, 4, 5, 6, 7, 8, and these are equally likely outcomes. What is the probability that it will point at



Fig. 7.7

(i) 8?

(ii) An odd number?

(iii) A number greater than 2?

(iv) A number less than 9?

(v) A multiple of 3?

ANSWER

S = {1, 2, 3, 4, 5, 6, 7, 8}, so there are 8 equally likely outcomes.

(i) 8

Favourable: {8} → P = 1/8

(ii) An odd number

Favourable: {1, 3, 5, 7} → P = 4/8 = 1/2

(iii) A number greater than 2

Favourable: {3, 4, 5, 6, 7, 8} → P = 6/8 = 3/4

(iv) A number less than 9

Favourable: {1, 2, 3, 4, 5, 6, 7, 8}, all 8 outcomes → P = 8/8 = 1 (a certain event)

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(v) **A multiple of 3**

Favourable: {3, 6} → P = 2/8 = 1/4

(i) 1/8 (ii) 1/2 (iii) 3/4 (iv) 1 (v) 1/4

QUESTION 10 *

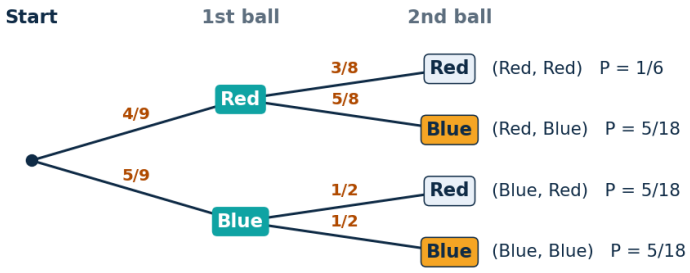
A basket contains 4 red balls and 5 blue balls. One ball is drawn and laid aside, and a second ball is drawn. Draw a tree diagram to represent the possible outcomes and probabilities. Use the tree diagram to answer the following questions.

(i) What is the probability of drawing a red ball and then a blue ball?

(ii) What is the probability of drawing 2 blue balls?

ANSWER

There are 9 balls at the start. Since the first ball is not put back, only 8 balls remain for the second draw, and the second-draw probabilities depend on the colour of the first ball drawn.



Tree diagram (without replacement); highlighted outcomes are used in (i) and (ii)

First red (4/9): 3 red + 5 blue remain, so P(red) = 3/8 and P(blue) = 5/8
First blue (5/9): 4 red + 4 blue remain, so P(red) = 4/8 = 1/2 and P(blue) = 1/2

(i) **A red ball and then a blue ball**

P(Red, Blue) = 4/9 × 5/8 = 20/72 = 5/18

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(ii) Two blue balls

$$P(\text{Blue, Blue}) = 5/9 \times 4/8 = 20/72 = 5/18$$

Check: the four probabilities 12/72 + 20/72 + 20/72 + 20/72 add up to 72/72 = 1.

(i) 5/18 ≈ 0.278 (ii) 5/18 ≈ 0.278

QUESTION 11 *

I throw a pair of 6-sided dice. Write down an event that has a probability of 0 and an outcome that has a probability of 1.

ANSWER

When a pair of dice is thrown, the sample space has 6 × 6 = 36 equally likely outcomes (a, b), with a and b from 1 to 6. The sum of the two numbers is from 2 to 12.

A An event with probability 0

The event ‘the sum of the two numbers is 13’ (or ‘the sum is 1’, or ‘both dice show 7’) contains no outcome of the sample space, so it is impossible.

$$E = \{\ \},\ n(E) = 0,\ P(E) = 0 \div 36 = 0$$

B A result with probability 1

The event ‘the sum is at most 12’ (or ‘the sum is at least 2’, or ‘the sum is between 2 and 12’) contains all 36 outcomes, so it is certain.

$$E = S,\ n(E) = 36,\ P(E) = 36 \div 36 = 1$$

(No single outcome such as (3, 4) has probability 1: each of the 36 outcomes has probability 1/36. So the ‘outcome with probability 1’ must be understood as a certain event.)

Probability 0: the sum is 13. Probability 1: the sum is at most 12 (a number between 2 and 12).

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QUESTION 12 *

Write the sample space and calculate the probability based on the given information.

(i) Two dice are rolled. What is the probability that the sum is a prime number greater than 5?

(ii) A bag contains 4 red, 3 green, and 2 blue balls. Two balls are drawn without replacement. What is the probability that both are of different colours?

(iii) Three coins are tossed. What is the probability that the first coin shows heads and exactly two heads occur in total?

(iv) A four-digit number is formed using the digits 1, 2, 3, and 4 with no repetition. What is the probability that the number is even?

(v) A student takes a multiple-choice test with 3 questions, each having 4 options (A, B, C, D), with only one correct answer. What is the probability that the student guesses and gets exactly 2 answers correct?

ANSWER

(i) Sum of two dice is a prime greater than 5

The sample space has 36 equally likely ordered pairs (a, b). The possible sums are 2 to 12; the primes greater than 5 are 7 and 11.

Sum 7: (1, 6), (2, 5), (3, 4), (4, 3), (5, 2), (6, 1) → 6 outcomes
Sum 11: (5, 6), (6, 5) → 2 outcomes
P = 8/36 = 2/9

(ii) Two balls of different colours (without replacement)

There are 9 balls (4 red, 3 green, 2 blue). The sample space consists of all pairs of two different balls: 9 × 8 ÷ 2 = 36 equally likely pairs. The pairs of the same colour are:

Both red: 4 × 3 ÷ 2 = 6 pairs
Both green: 3 × 2 ÷ 2 = 3 pairs
Both blue: 1 pair
Same colour: 6 + 3 + 1 = 10 pairs, so different colours: 36 – 10 = 26 pairs
P(different colours) = 26/36 = 13/18

Check with probabilities: P(same colour) = 4/9 × 3/8 + 3/9 × 2/8 + 2/9 × 1/8 = (12 + 6 + 2)/72 = 5/18, and 1 – 5/18 = 13/18.

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(iii) **First coin heads and exactly two heads in total**

S = {HHH, HHT, HTH, HTT, THH, THT, TTH, TTT}, n(S) = 8
First coin H and exactly two heads: E = {HHT, HTH}
P(E) = 2/8 = 1/4

(iv) **Four-digit number from the digits 1, 2, 3, 4 is even**

Using each digit once gives 4 × 3 × 2 × 1 = 24 equally likely numbers. The number is even when the last digit is 2 or 4. For each choice of the last digit, the other 3 digits can be arranged in 3 × 2 × 1 = 6 ways, so there are 2 × 6 = 12 even numbers.

Even numbers (last digit 2): 1342, 1432, 3142, 3412, 4132, 4312
Even numbers (last digit 4): 1234, 1324, 2134, 2314, 3124, 3214
P(even) = 12/24 = 1/2

(v) **Guessing exactly 2 of 3 answers**

Each question has 4 options, so there are 4 × 4 × 4 = 64 equally likely ways to answer the test by guessing. For exactly 2 correct answers, choose the question that is wrong (3 ways); it can be answered wrongly in 3 ways (the three wrong options); the other two answers are the correct ones. So the favourable outcomes number 3 × 3 = 9.

P(exactly 2 correct) = 9/64 ≈ 0.141
Check using probabilities: 3 × (1/4 × 1/4 × 3/4) = 9/64

(i) 2/9 (ii) 13/18 (iii) 1/4 (iv) 1/2 (v) 9/64

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QUESTION 13 *

A box contains 4 balls numbered 1 to 4. Record a sample space using a tree diagram for the following experiments:

(i) A ball is drawn, and the number is recorded. Then the ball is returned, and a second ball is drawn and recorded.

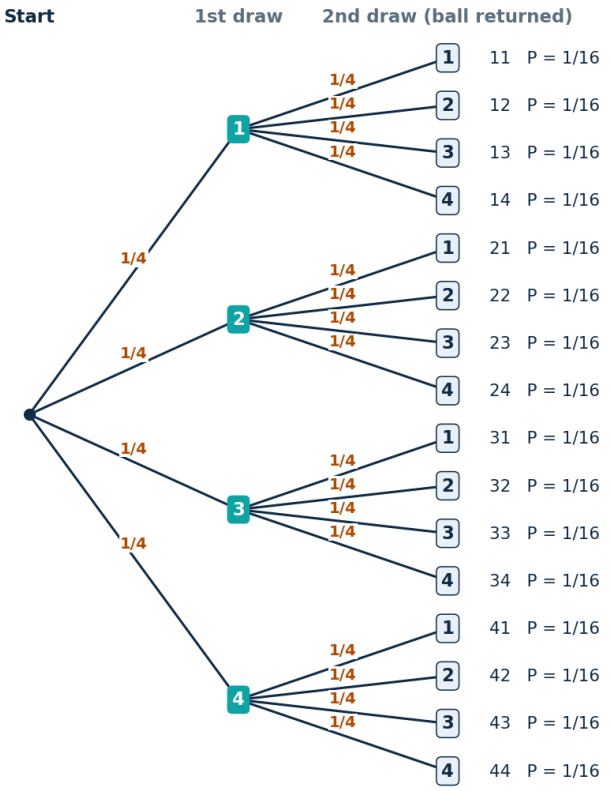
(ii) A ball is drawn and recorded. Without replacing the first ball, the experimenter draws and records a second ball.

(iii) What are the sizes of these two sample spaces?

ANSWER

(i) With replacement

The ball is returned, so all 4 balls are available for the second draw: each of the 4 first outcomes has 4 branches.



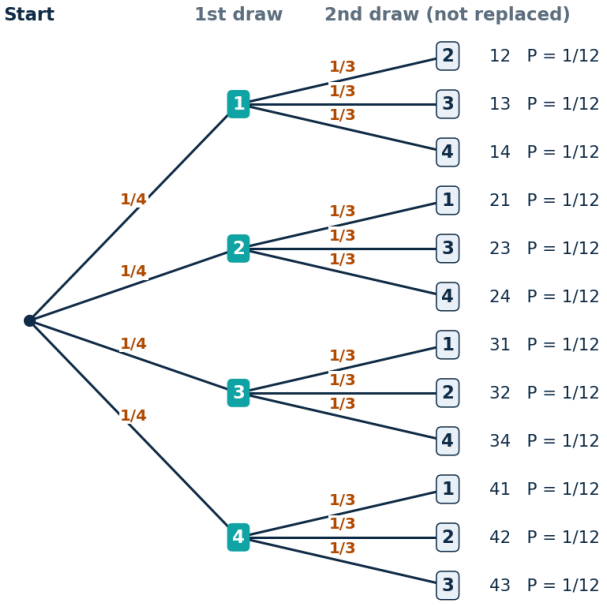
Tree diagram: with replacement

S = {11, 12, 13, 14, 21, 22, 23, 24, 31, 32, 33, 34, 41, 42, 43, 44}

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(ii) Without replacement

The first ball is not returned, so only 3 balls remain: each of the 4 first outcomes has 3 branches (the same number cannot appear twice).



Tree diagram: without replacement

S = {12, 13, 14, 21, 23, 24, 31, 32, 34, 41, 42, 43}

(iii) Sizes of the sample spaces

With replacement: n(S) = 4 × 4 = 16

Without replacement: n(S) = 4 × 3 = 12

The sample spaces have 16 and 12 elements respectively.

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QUESTION 14 *

List the elements of a sample space for the simultaneous tossing of a coin and drawing of a card from a set of 6 cards numbered 1 through 6.

ANSWER

The coin gives H or T and the card gives one of 1 to 6, so there are 2 × 6 = 12 outcomes.

S = {H1, H2, H3, H4, H5, H6, T1, T2, T3, T4, T5, T6}
n(S) = 12

The sample space has 12 elements (each one a pair: coin result, card number).

QUESTION 15 *

Three coins are tossed, and the number of heads is recorded. Which of the following lists is a sample space for this experiment? Why do the other lists fail to qualify as a sample space?

(i) {1, 2, 3}

(ii) {0, 1, 2}

(iii) {0, 1, 2, 3, 4}

(iv) {0, 1, 2, 3}

ANSWER

With three coins the number of heads can be 0 (TTT), 1 (e.g. HTT), 2 (e.g. HHT) or 3 (HHH). A sample space must contain every possible outcome, and only possible outcomes.

(i) {1, 2, 3}: fails, since the possible outcome 0 (all three tails, TTT) is missing
(ii) {0, 1, 2}: fails, since the possible outcome 3 (HHH) is missing
(iii) {0, 1, 2, 3, 4}: fails, since 4 heads cannot occur with three coins; it lists an outcome that is not possible
(iv) {0, 1, 2, 3}: contains every possible outcome and nothing else

Only list (iv) {0, 1, 2, 3} is a sample space for this experiment.

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QUESTION 16 *

Suppose you drop a dye at random on the rectangular region shown in Fig. 7.8. What is the probability that it will land inside the circle with a diameter of 1 m?



Fig. 7.8 (rectangle 3 m by 2 m)

ANSWER

The dye can land anywhere in the rectangle, and each part of the rectangle is equally likely, so the probability is proportional to area. The circle lies inside the rectangle.

Area of the rectangle = $3 \times 2 = 6$ m^2

Radius of the circle = 1/2 m, so its area = $\pi \times (1/2)^2 = \pi/4$ m^2 ≈ 0.785 m^2

P(inside the circle) = $(\pi/4) \div 6 = \pi/24 \approx 3.1416/24 \approx 0.131$

The probability that the dye lands inside the circle is $\pi/24 \approx 0.13$ (about 13%).

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IT

CLASS 9 MATHS · GANITA MANJARI · CHAPTER 7

In-Text Questions

Solutions · 3 questions

THINK AND REFLECT · COIN TOSS

Such unpredictability can be useful sometimes! For example, in a cricket match, the fact that a coin is tossed to decide which team will bat first is considered to be a fair method. Can you explain why?

ANSWER

A fair (unbiased) coin is symmetrical, so heads and tails are equally likely: each has probability 1/2. Hence each captain has exactly the same chance, 50%, of winning the toss, and neither team is favoured.

Also, the result of a toss is random: nobody can predict or control whether it will be heads or tails, so neither team can influence the result in its favour (the coin is allowed to fall freely, without interference).

Because the two outcomes are equally likely and cannot be predicted or controlled, the toss gives both teams an equal chance, which makes it a fair method.

THINK AND REFLECT · FRIEND'S GUESS

Ask your friend to predict the outcome of a ₹1 coin you toss. Do you see that your friend could guess heads or tails but could not know for certain?

ANSWER

Yes. When you toss the coin, the possible outcomes are known (heads or tails), but the outcome of a particular toss cannot be known beforehand. Your friend can only guess, and the guess is right with probability 1/2. Repeating the activity a number of times, your friend will be right about half the time, whatever method is used to guess.

Yes: all the possible results are known (H, T), but each individual toss is unpredictable. That is randomness.

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THINK AND REFLECT · EXAMPLE 7

Can you calculate the probability of getting one head and one tail?

(Experiment: toss a fair coin two times; S = {HH, HT, TH, TT}.)

ANSWER

The event ‘one head and one tail’ contains two outcomes of the sample space, HT and TH. Using the tree diagram, each outcome has probability 1/2 × 1/2 = 1/4.

E = {HT, TH}, n(E) = 2, n(S) = 4

P(one head and one tail) = P(HT) + P(TH) = 1/4 + 1/4 = 2/4 = 1/2

The probability of getting one head and one tail is 1/2 = 0.5 (50%).

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