Year 7 · Probability: Testing Your Luck with Experiments

Name: _____ Date: _____

Hi! This sheet is all about experimental probability, what actually happens when you run a chance experiment, and how it compares to what we expect. Grab a coin, a die, and something to record your results, and let's find out!

Warm-up

1. Aroha tossed a coin 40 times and got 22 heads. Write the experimental probability of getting heads as a fraction.

2. Write 11/20 as a decimal.

3. A spinner has 4 equal-sized colours: red, blue, green and yellow. What is the theoretical probability of landing on blue?

4. In 50 rolls of a die, the number 6 came up 9 times. What is the experimental probability of rolling a 6?

Practice

5. Tama rolled an ordinary six-sided die 30 times and recorded these results: 1 appeared 4 times, 2 appeared 6 times, 3 appeared 5 times, 4 appeared 3 times, 5 appeared 7 times, 6 appeared 5 times. Calculate the experimental probability of rolling a 5.

6. For the same 30 rolls above, what is the theoretical probability of rolling a 5, and how does it compare to the experimental result?

7. Explain what would likely happen to the experimental probability of rolling a 5 if Tama rolled the die 600 times instead of 30.

8. Mereana runs a chance experiment by tossing a coin 100 times. She gets 46 heads and 54 tails. Find the experimental probability of heads and of tails, then compare each to its theoretical probability.

9. At the Avondale Primary gala, a game uses a bag with 3 red counters and 2 blue counters. Ravi draws a counter, records the colour, and puts it back, doing this 40 times. He records 26 reds and 14 blues. What is the experimental probability of red, and what is the theoretical probability of red?

10. Sione suspects a die is weighted. He rolls it 120 times and the number 3 comes up 40 times. What is the experimental probability of rolling a 3, and does this support his suspicion? Explain.

Challenge

11. Two students test the same spinner with 3 equal sections (A, B, C). Ana does 30 spins and gets A: 14, B: 9, C: 7. Ben does 300 spins and gets A: 104, B: 98, C: 98. The theoretical probability of each section is 1/3 ≈ 0.33. Whose results are closer to the theoretical probability, and what does this show?

12. A game charges $2 to spin a wheel with 10 equal sections: 9 sections say 'Lose' and 1 says 'Win $15'. In 200 spins, the wheel landed on 'Win' 18 times. (a) Find the experimental probability of winning. (b) Compare it to the theoretical probability. (c) Over these 200 spins, did the game organiser make or lose money?

Answer key (for parents and tutors)

1. Aroha tossed a coin 40 times and got 22 heads. Write the experimental probability of getting heads as a fraction.
   Experimental probability = number of heads ÷ total tosses = 22 ÷ 40 = 22/40, which simplifies to 11/20.
2. Write 11/20 as a decimal.
   11 ÷ 20 = 0.55. (You can also think of it as 55/100 = 0.55.)
3. A spinner has 4 equal-sized colours: red, blue, green and yellow. What is the theoretical probability of landing on blue?
   There are 4 equal outcomes and only 1 is blue, so the theoretical probability = 1/4 = 0.25.
4. In 50 rolls of a die, the number 6 came up 9 times. What is the experimental probability of rolling a 6?
   Experimental probability = 9 ÷ 50 = 9/50 = 0.18.
5. Tama rolled an ordinary six-sided die 30 times and recorded these results: 1 appeared 4 times, 2 appeared 6 times, 3 appeared 5 times, 4 appeared 3 times, 5 appeared 7 times, 6 appeared 5 times. Calculate the experimental probability of rolling a 5.
   Experimental probability of a 5 = number of 5s ÷ total rolls = 7 ÷ 30 = 7/30 ≈ 0.23. (Check: 4+6+5+3+7+5 = 30 rolls, so the total is correct.)
6. For the same 30 rolls above, what is the theoretical probability of rolling a 5, and how does it compare to the experimental result?
   Theoretical probability = 1/6 ≈ 0.17. The experimental result was 7/30 ≈ 0.23, which is a bit higher than 1/6. They differ because 30 trials is a fairly small number, so random chance made 5 come up a little more often than expected.
7. Explain what would likely happen to the experimental probability of rolling a 5 if Tama rolled the die 600 times instead of 30.
   With many more trials, the experimental probability would get closer to the theoretical probability of 1/6 ≈ 0.17. This is the Law of Large Numbers: as the number of trials increases, the experimental probability moves nearer to the theoretical probability.
8. Mereana runs a chance experiment by tossing a coin 100 times. She gets 46 heads and 54 tails. Find the experimental probability of heads and of tails, then compare each to its theoretical probability.
   Experimental P(heads) = 46/100 = 0.46. Experimental P(tails) = 54/100 = 0.54. The theoretical probability of each is 1/2 = 0.5. Both results are close to 0.5, but not exactly, because even 100 trials still has some random variation. With more tosses they would be expected to get even closer to 0.5.
9. At the Avondale Primary gala, a game uses a bag with 3 red counters and 2 blue counters. Ravi draws a counter, records the colour, and puts it back, doing this 40 times. He records 26 reds and 14 blues. What is the experimental probability of red, and what is the theoretical probability of red?
   Experimental P(red) = 26/40 = 13/20 = 0.65. Theoretical P(red) = 3 red out of 5 counters = 3/5 = 0.6. The experimental value (0.65) is close to the theoretical value (0.6). The small difference is due to natural variation in 40 trials; doing more draws would usually bring the experimental probability nearer to 0.6.
10. Sione suspects a die is weighted. He rolls it 120 times and the number 3 comes up 40 times. What is the experimental probability of rolling a 3, and does this support his suspicion? Explain.
    Experimental P(3) = 40/120 = 1/3 ≈ 0.33. For a fair die the theoretical probability of a 3 is 1/6 ≈ 0.17. Since 120 is a large number of trials, we would expect the experimental result to be near 1/6 if the die were fair. Getting 0.33 (about double) suggests the die may indeed be weighted towards 3. To be more sure, Sione could roll it even more times and see if the result stays near 1/3.
11. Two students test the same spinner with 3 equal sections (A, B, C). Ana does 30 spins and gets A: 14, B: 9, C: 7. Ben does 300 spins and gets A: 104, B: 98, C: 98. The theoretical probability of each section is 1/3 ≈ 0.33. Whose results are closer to the theoretical probability, and what does this show?
    Ana's experimental probabilities: A = 14/30 ≈ 0.47, B = 9/30 = 0.30, C = 7/30 ≈ 0.23. Ben's experimental probabilities: A = 104/300 ≈ 0.35, B = 98/300 ≈ 0.33, C = 98/300 ≈ 0.33. Ben's results are all much closer to 1/3 ≈ 0.33 than Ana's. This shows the Law of Large Numbers: Ben ran many more trials (300 vs 30), so his experimental probabilities are closer to the theoretical probability.

12. A game charges $2 to spin a wheel with 10 equal sections: 9 sections say 'Lose' and 1 says 'Win $15'. In 200 spins, the wheel landed on 'Win' 18 times. (a) Find the experimental probability of winning. (b) Compare it to the theoretical probability. (c) Over these 200 spins, did the game organiser make or lose money?
(a) Experimental P(win) = 18/200 = 9/100 = 0.09. (b) Theoretical P(win) = 1/10 = 0.10. The experimental value (0.09) is very close to 0.10; the small difference is normal random variation, and with even more spins it would be expected to sit near 0.10. (c) Money in from 200 spins = 200 × $2 = $400. Money paid out for 18 wins = 18 × $15 = $270. Profit = $400 − $270 = $130. The organiser made $130.