

Chance Check Lab

Simulate outcomes, then compare probabilities.

GRADE 7 • MA.7.DP.2.4

MA.7.DP.2.4 "Use a simulation of a simple experiment to find experimental probabilities and compare them to theoretical probabilities."

NAME _____

DATE _____

EXPERIMENTAL VS. THEORETICAL

Experimental probability = event count $\div$ total trials.
Theoretical probability = favorable equally likely outcomes $\div$ all equally likely outcomes. Random variation can make them differ. With many repetitions, experimental results typically approach theory, but a larger sample is not guaranteed to be closer. Materials: a fair coin, pencil and 20 small marks of scratch work if needed.

WORKED EXAMPLE

A simulation uses a spinner with 8 equal sections, exactly one marked with a star. In 22 spins, the star section appears 7 times. Find the experimental probability of star and compare it to the theoretical probability.

1. Experimental probability = $7/22$.
2. Theoretical probability = $1/8$.
3. Compare: $7/22 = 56/176$ and $1/8 = 22/176$.

Answer: Experimental probability: $7/22$. Theoretical probability: $1/8$. The experimental probability is greater.

PRACTICE 4 problems

- 1** A game awards a bonus with probability $1/2$. Simulate 20 plays by tossing a fair coin: H means bonus, T means no bonus. Record each H/T in its numbered box. Count H and T; check the total is 20. Find $P(\text{bonus})$ from your results and compare it with $1/2$ using $<$, $>$ or $=$.

ANSWER _____

1	2	3	4
5	6	7	8
9	10	11	12
13	14	15	16
17	18	19	20

- 2** A simulation rolls a fair 10-sided die labeled 0 through 9 a total of 27 times. The number 3 appears 3 times. Find the experimental probability of rolling 3 and the theoretical probability. Compare them.

ANSWER _____

- 3** A spinner has 6 equal sections, exactly one orange. In 35 simulated spins, orange appears 11 times. Find the experimental probability of orange and the theoretical probability of orange. Compare them.

ANSWER _____

- 4** A bag has 9 tiles, including 4 red tiles. A simulation draws a tile, records its color, and replaces it 36 times. Red is drawn 15 times. Find the experimental and theoretical probabilities of red. Compare them.

ANSWER _____

APPLY IT Show your work

- 1** A profile app is programmed to choose 1 of 4 icons with equal chance. The table shows 30 simulated icon choices. Find the experimental probability of Flame, the theoretical probability of Flame, and compare them.

ANSWER _____

SIMULATED ICON CHOICES

Icon	Times Chosen
Flame	13
Music	6
Game	5
Camera	6

Continue your coin simulation for 20 more plays. Record H/T below. Combine all 40 results. Find the new experimental $P(\text{bonus})$.

- 2** Compare its distance from $\frac{1}{2}$ with your first 20-play result: did it become closer, farther away or stay equally close? Explain why your result is possible.

1	2	3	4
5	6	7	8
9	10	11	12
13	14	15	16
17	18	19	20

CHALLENGE One step up

A fair spinner has 4 equal sections, and 1 section is blue. Team A gets blue 9 times in 28 spins. Team B gets blue 18 times in 68 spins. Which team's experimental probability is closer to the theoretical probability of blue? Explain by comparing each distance from $\frac{1}{4}$. Does the larger trial count alone guarantee that Team B would be closer? Explain.

WORK SPACE AND ANSWER

Do not replace student outcomes with a fixed answer. Check that the first and second records contain 20 outcomes each, and that reported probabilities match the actual counts and denominators. No exact 50/50 outcome is required. Typical long-run convergence is not a guarantee for each additional trial. Accept correct fraction, decimal or percentage probabilities.

PRACTICE 1

Results vary. If H occurs h times, T must occur $20 - h$ times. Experimental $P(\text{bonus}) = h/20$; theoretical $P(\text{bonus}) = 1/2$. Comparison depends on whether h is less than, equal to or greater than 10.

PRACTICE 2

Experimental: $3/27 = 1/9$. Theoretical: $1/10$. The experimental probability is greater.

PRACTICE 3

Experimental: $11/35$. Theoretical: $1/6$. The experimental probability is greater.

PRACTICE 4

Experimental: $15/36 = 5/12$. Theoretical: $4/9$. The experimental probability is less.

APPLY IT 1

Experimental: $13/30$. Theoretical: $1/4$. The experimental probability is greater.

Use the Flame count over all 30 choices for the experimental probability. Since 4 icons are equally likely, the theoretical probability is $1/4$.

APPLY IT 2

Results vary. If the first batch has h heads and this batch has k , the combined probability is $(h + k)/40$. Compare $|h/20 - 1/2|$ and $|(h + k)/40 - 1/2|$. All three outcomes are possible due to random variation. Keep the original 20 outcomes: combining means adding both head counts and using 40 trials. Do not discard a result because it differs from theory.

CHALLENGE

Team B is closer. Team A: $9/28$ is $1/14$ greater than $1/4$. Team B: $18/68 = 9/34$ is $1/68$ greater than $1/4$. Since $1/68$ is less than $1/14$, Team B is closer. No. These particular results are closer, but random variation means a larger sample is not guaranteed to be closer in every trial set.