Simulating Experiments Using a Random Digit Table

Statistics Worksheet · Grade 9–12

Name: ________________________________ Date: __________________

Learning Objectives

- Follow the four steps of simulation: state the problem, state assumptions, assign digits, and simulate
- Assign digits from a random digit table to represent outcomes based on their theoretical probabilities
- Use simulation results to estimate experimental probability and interpret findings

Problems

1. A simulation uses a random digit table to imitate chance behavior. List the four steps, in order, that must be followed when setting up and running a simulation.

2. A fair coin is tossed once. A student assigns odd digits (1, 3, 5, 7, 9) to represent Heads and even digits (0, 2, 4, 6, 8) to represent Tails. Explain why this assignment is valid for simulating a fair coin toss.

3. Use the random digit table row below to simulate 10 tosses of a fair coin. Odd digits represent Heads (H) and even digits represent Tails (T). Record each outcome, then state whether there is a run of 3 consecutive identical results.

Row 101: 1 9 2 2 3 9 5 0 3 4

4. A student wants to simulate rolling a standard six-sided die using a random digit table. Describe a valid way to assign single digits (0–9) to the six outcomes (1–6), and explain which digits, if any, would be ignored.

5. The table below shows the first 25 trials of a coin-tossing simulation (10 tosses per trial). A success (S) means a run of 3 or more consecutive identical outcomes occurred; failure (F) means it did not. Complete the blank cells and then estimate the probability of getting a run of 3.

Trial	Outcome Sequence	Run of 3?
1	H H H T H T T H H T	S

Trial	Outcome Sequence	Run of 3?
2	T H H H T T T H H T	S
3	H T T T H H T H T H	S
4	H T H T H T H T H T	F
5	T T H H T H T H H T	F
6	H H H H T T H T H T	S
7	T H T H T H T H T H	F
8	H H T T H H H T T H	S
9	T T T H H T H T H H	S
10	H T H H T T H H H T	S
11–25	...(remaining trials)	
Total S		
Total F		
Est. P		

6. A basketball player makes 70% of her free throws. Describe how to assign digits 0–9 to simulate each free throw attempt, then state the two key assumptions needed.

7. Using the free throw simulation setup from Problem 6, use the random digit row below to simulate 8 free throw attempts. How many shots did the player make in this trial?

Row 130: 4 7 2 8 1 3 9 6

8. A simulation of tossing a coin 10 times was repeated 50 times. A run of 3 consecutive identical outcomes (HHH or TTT) occurred in 41 out of the 50 trials. Based on this simulation, what is the estimated probability of getting a run of 3? Is this probability greater than, equal to, or less than 0.75?

$$\hat{p} = \frac{\text{successes}}{\text{total trials}}$$

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9. A student simulates drawing a card (with replacement) from a standard 52-card deck to find the probability of drawing a heart. She uses pairs of two-digit numbers (00–99). Describe a valid digit assignment and identify which two-digit numbers she should skip.

$$P(\text{heart}) = \frac{13}{52} = 0.25$$

10. A simulation was run to estimate the probability that a student passes at least 4 out of 5 quiz questions, given that each question has an independent 60% chance of being answered correctly. The digit assignment used was: digits 1–6 = Correct, digits 7–9 and 0 = Incorrect. The random digit row below represents one trial of 5 questions. Determine whether this trial is a success (at least 4 correct), and then explain why increasing the number of simulation trials improves the accuracy of the estimated probability.

Row 145: 3 9 6 1 5

Simulating Experiments Using a Random Digit Table — Answer Key

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Answer Key

1. Answer: 1) State the problem. 2) State the assumptions. 3) Assign digits to outcomes. 4) Simulate the experiment.

- Step 1: State the problem — describe exactly what probability you want to estimate.
- Step 2: State the assumptions — e.g., equal likelihood of outcomes, independence of trials.
- Step 3: Assign digits — map each possible outcome to an appropriate set of digits.
- Step 4: Simulate — read digits from Table B (or a random number generator) and record results.

2. Answer: Valid because exactly 5 of the 10 digits (0–9) are odd and 5 are even, giving each outcome a probability of 5/10 = 0.5, matching the fair coin's 50% chance for Heads and 50% for Tails.

- There are 10 equally likely digits: 0 through 9.
- Odd digits: 1, 3, 5, 7, 9 — that is 5 digits, so P(odd) = 5/10 = 0.5.
- Even digits: 0, 2, 4, 6, 8 — also 5 digits, so P(even) = 5/10 = 0.5.
- Since P(Heads) = P(Tails) = 0.5 for a fair coin, the assignment correctly models the experiment.

3. Answer: H H T T H H H T H T — Yes, there is a run of 3 (HHH at positions 5–7).

- Map each digit: 1→H, 9→H, 2→T, 2→T, 3→H, 9→H, 5→H, 0→T, 3→H, 4→T.
- Sequence: H H T T H H H T H T.
- Check for a run of 3: positions 5–7 give H H H — that is 3 consecutive Heads.
- Conclusion: This trial is a SUCCESS (run of 3 found).

4. Answer: Assign digit 1→outcome 1, 2→outcome 2, 3→outcome 3, 4→outcome 4, 5→outcome 5, 6→outcome 6, and ignore digits 0, 7, 8, 9.

- A six-sided die has 6 equally likely outcomes, each with probability 1/6.
- Assign digits 1 through 6 to represent faces 1 through 6 (one digit per face).
- Digits 0, 7, 8, and 9 do not correspond to any face — skip them and move to the next digit.
- Each valid digit still has probability 1/6 among the 6 used digits, preserving fairness.

5. Answer: Based on trials 1–10: 8 successes out of 10. If pattern continues similarly across 25 trials, estimated P ≈ 0.80 (answers will vary based on full simulation).

Trial	Outcome Sequence	Run of 3?
1	H H H T H T T H H T	S
2	T H H H T T T H H T	S
3	H T T T H H T H T H	S

Trial	Outcome Sequence	Run of 3?
4	H T H T H T H T H T	F
5	T T H H T H T H H T	F
6	H H H H T T H T H T	S
7	T H T H T H T H T H	F
8	H H T T H H H T T H	S
9	T T T H H T H T H H	S
10	H T H H T T H H H T	S
11–25	...(remaining trials)	Varies
Total S	≈20 out of 25	
Total F	≈5 out of 25	
Est. P	≈ 20/25 = 0.80	

- For each trial, scan the 10-toss sequence for any 3 or more identical consecutive results.
- Mark S (success) if found, F (failure) if not.
- Count total successes across all 25 trials.
- Estimated probability = (number of successes) / 25.

6. Answer: Assign digits 0–6 (7 digits) = Made; digits 7–9 (3 digits) = Missed. Assumptions: (1) P(make) = 0.70 is constant, (2) each free throw is independent.

- Since P(make) = 70% = 7/10, we need 7 of the 10 digits to represent a made free throw.
- Assign digits 0, 1, 2, 3, 4, 5, 6 → Made (7 digits out of 10 = 70%).
- Assign digits 7, 8, 9 → Missed (3 digits out of 10 = 30%).
- Assumption 1: The probability of making each free throw stays constant at 0.70.
- Assumption 2: Each free throw attempt is independent of all others.

7. Answer: Made 5 out of 8 free throws.

- Recall: digits 0–6 = Made, digits 7–9 = Missed.
- 4 → Made, 7 → Missed, 2 → Made, 8 → Missed, 1 → Made, 3 → Made, 9 → Missed, 6 → Made.
- Sequence: M, Miss, M, Miss, M, M, Miss, M.
- Count of makes = 5. So the player made 5 out of 8 in this trial.

8. Answer: Estimated P = 41/50 = 0.82, which is greater than 0.75.

- Estimated probability = number of successes / total number of trials.
- p■ = 41 / 50 = 0.82.
- Compare: 0.82 > 0.75.
- The estimated probability of getting a run of 3 in 10 coin tosses is 0.82, which is greater than 0.75.

9. Answer: Assign 00–24 (25 numbers) = Heart; 25–99 (75 numbers) = Not a Heart. No numbers need to be skipped since all 100 two-digit pairs (00–99) are used.

- P(heart) = 13/52 = 1/4 = 25%.
- Using two-digit numbers 00–99 gives exactly 100 equally likely pairs.
- Assign 25 of them to represent a Heart: 00–24 (25 numbers → 25/100 = 0.25). ✓
- Assign 25–99 (75 numbers → 75/100 = 0.75) to represent Not a Heart.
- All 100 numbers are used — no numbers need to be skipped.

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10. Answer: Trial result: C, I, C, C, C = 4 correct → SUCCESS. More trials reduce sampling variability, making the estimated probability converge toward the true theoretical probability.

- Recall: digits 1–6 = Correct (C), digits 0, 7, 8, 9 = Incorrect (I).
- Map the digits: 3 → C, 9 → I, 6 → C, 1 → C, 5 → C.
- Results: C, I, C, C, C — that is 4 correct out of 5.
- Since $4 \geq 4$, this trial is a SUCCESS.
- Why more trials help: With only a few trials, the estimated probability can vary widely due to chance. As the number of trials increases, the law of large numbers ensures the estimate gets closer and closer to the true probability (≈ 0.337 for this scenario).
