Worked answers | Probability

Designing and interpreting simulations

6 questions | 15 marks

Equivalent correct methods earn the corresponding marks.

1. Describe a random-digit simulation of a 30% chance. [2 marks]

Three of ten uniform digits represent success.

Answer: Use 0,1,2 for success and 3-9 for failure.

2. A simulation gives 47 events in 250 trials. Find relative frequency. [2 marks]

$\frac{47}{250} = 0.188.$

Answer: 0.188.

3. Explain why generating one uniform integer 2-12 does not simulate two dice sums. [2 marks]

Sum 7 has 6 pairs;sum 2 has 1.

Answer: Real sums have unequal numbers of ordered pairs.

4. Design a simulation of two counters drawn without replacement from 3 red and 2 blue. [3 marks]

This prevents reuse within a trial.

Resetting between trials restores the original experiment.

Answer: Shuffle five labelled items, three red and two blue, then take the first two; reshuffle for each new trial.

5. Runs of 100 and 1000 trials estimate $P(A)$ as 0.66 and 0.604. If the theoretical probability is 0.6, which is closer and by how much? [3 marks]

Calculate $|0.66 - 0.6| = 0.06$ and $|0.604 - 0.6| = 0.004$.

Compare their errors: $0.06 - 0.004 = 0.056$.

Answer: The 1000-trial estimate is closer. The absolute errors are 0.06 and 0.004, so its error is smaller by 0.056.

6. Does a larger run guarantee that every 1000-trial simulation estimate is closer to the theoretical probability than every 100-trial estimate? Explain. [3 marks]

It compares only two particular runs.

Random fluctuations can make a larger finite run less accurate.

Answer: No.