Probability - Applications test

16 questions | 47 marks | 60 minutes

Apply probability and evaluate simulation choices.

Equivalent correct methods earn the corresponding marks.

1. A uniform random four-digit code may begin with zero and may repeat digits. How many possible codes are there? [2 marks]

Ten choices in each of four positions give 10^4.

Answer: 10,000.

2. A four-digit code is chosen uniformly from digits 0-9. Repeats and a leading zero are allowed. Find P(the code is 0000). [2 marks]

Exactly one of the 10,000 equally likely codes is 0000.

Answer: 1/10,000.

3. Six volunteers fill two different roles. Count the possible assignments. [2 marks]

6 choices for the first role and 5 for the second.

Answer: 30.

4. Six volunteers form a two-person group with no different roles. Count the groups and explain why this differs from assigning two different roles to six people. [3 marks]

The 30 ordered selections count each group twice.

Divide by 2 because exchanging the people does not change the group.

Answer: 15.

5. Two counters are drawn from 3 red and 2 blue. [4 marks]

(a) Find P(two red) without replacement. [2 marks]

(3/5)(2/4)=3/10.

Answer: 3/10.

(b) Find P(two red) with replacement. [2 marks]

(3/5)^2=9/25.

Answer: 9/25.

6. Using the club table, find the probability a chosen student belongs to neither club. [2 marks]

Invented membership data for 60 students.

Music membership	Drama	Not drama	Total
Music	8	12	20
Not music	10	30	40
Total	18	42	60

The neither count is 30 out of 60.

Answer: 1/2.

7. A raffle has 50 student tickets,30 teacher tickets and 20 community tickets. Draw two tickets without replacement. Find P(both student). [3 marks]

(50/100)(49/99)=2450/9900=49/198.

Answer: 49/198.

8. A raffle has 50 student tickets, 30 teacher tickets and 20 community tickets. Two tickets are drawn uniformly without replacement. Find P(exactly one teacher ticket). [3 marks]

Teacher then non-teacher:(30/100)(70/99)=7/33.

The reverse order also gives 7/33;total 14/33.

Answer: 14/33.

9. Two fair dice are rolled. Given at least one die shows 6, find P(sum 7). [3 marks]

There are 11 ordered pairs with at least one 6.

Only(1,6) and(6,1) sum to 7.

Answer: 2/11.

10. A simulation uses independent uniform random digits 0-9, with 0-5 meaning success. In 20 digits there are 13 successes. Estimate the success probability and compare it with the model probability. [3 marks]

13/20=0.65.

The observed estimate is 0.05 higher; variation is expected.

Answer: Estimate 0.65; model probability 0.6.

11. A simulation generates sums 2-12 uniformly and reports P(sum 7) near 1/11. Explain why this is not a fair two-dice simulation. [3 marks]

Two dice have 36 ordered pairs,6 of which sum to 7.

Generate the two die values independently and then add.

Answer: The generator gives each sum equal probability, unlike two dice.

12. P(A)=0.7, P(B)=0.5 and P(A and B)=0.4. [4 marks]

(a) Find P(A|B). [2 marks]

0.4/0.5=0.8.

Answer: 0.8.

(b) Are the events independent? [2 marks]

0.8 differs from P(A)=0.7.

Answer: No.

13. In a survey,18 of 30 regular walkers and 22 of 40 other students join a sports club. Compare club membership rates. [3 marks]

18/30=0.6;22/40=0.55.

The walker rate is 5 percentage points higher.

Answer: 0.6 for walkers and 0.55 for others.

14. A survey finds that 18 of 30 regular walkers and 22 of 40 other students join a sports club. Does this prove that walking causes club membership? Explain one limitation. [3 marks]

The groups may differ in other ways, such as existing interest in sport.

An observational association does not isolate a cause.

Answer: No.

15. Assume rain on two days is independent and each day has rain probability 0.3. Find P(rain on at least one day). [3 marks]

No rain on either day has probability $0.7\times0.7=0.49$.

The complement is $1-0.49=0.51$.

Answer: 0.51.

16. Design and describe a simulation to estimate P(two red counters) from 3 red and 2 blue without replacement. State what to record and how to form the estimate. [4 marks]

The shuffle models equal chances for each counter.

No item is reused inside a trial.

Restoring between trials keeps experiments comparable.

Repeat many times and report relative frequency with random variation.

Answer: Randomly shuffle five labelled counters, take the first two, record whether both are red, then restore and reshuffle for each trial. Estimate by RR count divided by trials.