Probability of Simple and Compound Events

Spot mistakes, reason, and work backward

Name _____ **Date** _____ **Score** _____ / 10

QUICK REVIEW

Before multiplying probabilities, check whether the first event changes the second. From 3 red and 2 blue counters, two reds without replacement have probability $(3/5)(2/4) = 3/10$; with replacement it is $(3/5)^2 = 9/25$. "At least one often uses a complement. Experimental relative frequency is an estimate, not necessarily the theoretical probability of a fair device.

Worked example

Example for form 2: a bag has 4 red and 4 blue counters. Find P(red) on one uniform draw.

1. There are $4 + 4 = 8$ counters in total. The favorable group consists of the 4 red counters, each equally likely to be selected.
2. Divide favorable by total: $P(\text{red}) = 4/8 = \frac{1}{2}$. The remaining counters form the complementary event, blue.
Answer: $P = \frac{1}{2}$

Practice Problems

Show your thinking.

1. A learner uses $(4/7)^2$ for two reds from 4 red and 3 blue counters without replacement. Correct it.

2. A learner uses $1/3$ for exactly one head in two independent fair tosses. Correct the sample space.

3. A learner adds 3 even faces and 2 faces above 4 on a die, reporting 5/6 for their union. Correct it.

4. An equal-sector spinner has 10 sectors, 3 blue. Find the complement probability, not the blue probability.

5. Two draws from 3 black and 1 white counter use replacement. A learner shrinks the second denominator. Correct P(two black).

6. A fair die was rolled 20 times and showed six 7 times. Give the theoretical, not experimental, probability of six next.

7. A bag has 12 counters and $P(\text{red}) = 1/3$ under uniform selection. How many are red?

8. A learner says two fair tosses guarantee one head. Find the probability of no heads to test the claim.

9. A die is rolled once. Can even and odd happen together? Calculate P(even and odd).

10. A bag has 1 red and 4 blue counters. Without replacement, can both of two draws be red? Calculate.

Answer Key

1. $P = \frac{2}{7}$
2. $P = \frac{1}{2}$
3. $P = \frac{2}{3}$
4. $P = \frac{7}{10}$
5. $P = \frac{9}{16}$
6. $P = \frac{1}{6}$
7. 4 red counters.
8. $P = \frac{1}{4}$
9. $P = 0$
10. $P = 0$

Step-by-Step Solutions

Follow each calculation, then check your own work.

Problem 1

1. The first-red chance is $4/7$. Removing a red leaves 3 red counters out of 6, giving second-red chance $3/6$.

2. The correct result is $(4/7)(3/6) = 12/42 = 2/7$, not $(4/7)^2$. The original expression incorrectly assumes replacement.

Problem 2

1. The equally likely ordered outcomes are HH, HT, TH, TT. Exactly one head occurs in HT and TH, which are distinct outcomes.

2. Thus $P = 2/4 = 1/2$. Treating the counts zero, one, and two heads as three equally likely possibilities gives the incorrect $1/3$.

Problem 3

1. Even faces are $2, 4, 6$ and faces above 4 are $5, 6$. Face 6 occurs in both lists.

2. Subtract the overlap: favorable count $= 3 + 2 - 1 = 4$. The correct probability is $4/6 = 2/3$, not $5/6$.

Problem 4

1. Blue has probability $3/10$. The other $10 - 3 = 7$ sectors make up the event not blue.

2. Use the complement: $1 - 3/10 = 7/10$. This is larger than the blue chance because seven sectors qualify rather than three.

Problem 5

1. The first-black probability is $3/4$. Replacement restores 3 black among 4 counters before the next draw.

2. The second probability is also $3/4$. Multiply: $(3/4)(3/4) = 9/16$; shrinking the denominator would describe a different experiment.

Problem 6

1. The empirical frequency is $7/20$, but the next roll of the stated fair die still has six equally likely faces.

2. Exactly one face is a six, so the theoretical chance remains $1/6$. Earlier outcomes do not change the face probabilities of an independent roll.

Problem 7

1. Let r be the red count. The probability condition is $r/12 = 1/3$, so multiply by 12 to get $r = 12/3$.

2. Thus $r = 4$. Checking the count gives $4/12 = 1/3$; the remaining $12 - 4 = 8$ counters are not red.

Problem 8

1. No heads means outcome TT. Independence gives $P(TT) = (1/2)(1/2) = 1/4$.

2. Because $1/4 > 0$, a head is not guaranteed in two tosses. Long-run balance does not force one head and one tail in each pair of trials.

Problem 9

1. The even set is $\{2, 4, 6\}$ and the odd set is $\{1, 3, 5\}$. Their intersection contains no outcomes.

2. Therefore $P(\text{even and odd}) = 0/6 = 0$. Multiplying $1/2$ by $1/2$ would be inappropriate: these events on one roll are mutually exclusive.

Problem 10

1. The first-red chance is $1/5$. If that red is drawn, there are 0 reds among the 4 remaining counters.

2. The product is $(1/5)(0/4) = 0/20 = 0$. There is only one red counter, so two red draws without replacement are impossible.

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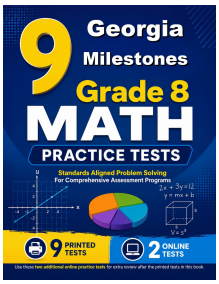

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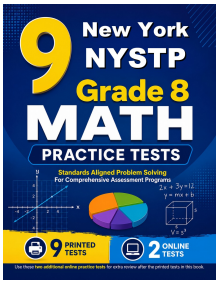

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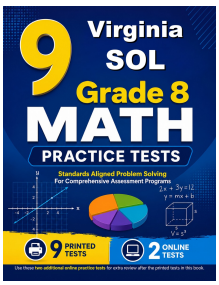

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