Simulating Compound Events

Spot mistakes, reason, and work backward

Name _____ **Date** _____ **Score** _____ / 6

QUICK REVIEW

Each practice entry is an ordered pair of independent uniform digits from 0 to 9. Match each chance with the right number of digit labels; for $1/10$, use one label. Count whole trials, not separate digits.

Worked example

Model independent stage chances $1/2$ and $1/5$. Using separate digits, how can both stages pass? Find the model chance.

1. Use 5 of 10 labels for the first chance: $5/10 = 1/2$.
2. Use 2 of 10 labels for the second chance: $2/10 = 1/5$.
3. With independent digits, both pass with chance $(5/10)(2/10) = 1/10$.

Answer: First 0 to 4, second 0 to 1; both $1/10$.

Practice Problems

Show your thinking.

1. A win needs first digit 0 or 1 and second digit at least 4. A student counts each successful digit as a win. Give that incorrect tally, the true win count, and the corrected rate.

Trial number: (first digit, second digit)				
$1:(7,6)$	$2:(6,2)$	$3:(2,8)$	$4:(3,7)$	$5:(2,1)$
$6:(8,6)$	$7:(3,2)$	$8:(0,4)$	$9:(0,1)$	$10:(6,4)$
$11:(4,3)$	$12:(8,4)$	$13:(1,5)$	$14:(2,7)$	$15:(1,6)$
$16:(4,7)$	$17:(7,2)$	$18:(5,9)$	$19:(7,6)$	$20:(9,0)$

2. Two independent checks each pass with chance $3/10$, modeled by digits 0 to 2. A student reuses one digit for both. Compare both-pass model chances with and without reuse, then find the rate from the independent pairs.

Trial number: (first digit, second digit)				
$1:(8,4)$	$2:(3,8)$	$3:(6,2)$	$4:(8,5)$	$5:(0,0)$
$6:(0,2)$	$7:(8,8)$	$8:(9,7)$	$9:(5,1)$	$10:(0,2)$
$11:(0,8)$	$12:(7,3)$	$13:(7,8)$	$14:(4,2)$	$15:(0,9)$
$16:(2,0)$	$17:(1,7)$	$18:(2,4)$	$19:(5,0)$	$20:(1,5)$

3. A win needs at least one digit in $\{8,9\}$. A student counts only pairs with both digits in that set. Which trials were missed? Find the corrected observed rate.

Trial number: (first digit, second digit)				
$1:(7,7)$	$2:(5,8)$	$3:(2,5)$	$4:(5,7)$	$5:(1,1)$
$6:(8,2)$	$7:(5,5)$	$8:(1,0)$	$9:(7,4)$	$10:(2,2)$
$11:(3,8)$	$12:(9,3)$	$13:(1,3)$	$14:(9,8)$	$15:(8,9)$
$16:(6,8)$	$17:(4,7)$	$18:(9,4)$	$19:(8,3)$	$20:(3,4)$

4. The first digit must be smaller than the second. A student divides observed wins by 100 because there are 100 possible pairs. Compute the correct observed and model rates. Do they match here?

Trial number: (first digit, second digit)				
$1:(0,4)$	$2:(1,9)$	$3:(2,5)$	$4:(2,1)$	$5:(7,5)$
$6:(8,5)$	$7:(2,5)$	$8:(9,6)$	$9:(0,5)$	$10:(1,0)$
$11:(5,9)$	$12:(1,8)$	$13:(8,4)$	$14:(9,4)$	$15:(9,6)$
$16:(4,7)$	$17:(5,4)$	$18:(7,9)$	$19:(8,3)$	$20:(7,4)$

5. A rule needs an odd first digit and second digit 0 to 2. A student reverses the positions when tallying. Give the reversed and correct counts and the correct observed rate.

Trial number: (first digit, second digit)				
$1:(2,4)$	$2:(5,7)$	$3:(0,4)$	$4:(6,7)$	$5:(8,0)$
$6:(4,4)$	$7:(6,7)$	$8:(0,2)$	$9:(5,1)$	$10:(4,0)$
$11:(9,0)$	$12:(2,9)$	$13:(1,6)$	$14:(0,6)$	$15:(2,0)$
$16:(8,0)$	$17:(3,7)$	$18:(2,0)$	$19:(2,4)$	$20:(3,6)$

6. Exactly one digit below 5 wins. A student forecasts wins in 100 trials by adding 80 to the wins in this run. Correct the forecast and explain why it is an estimate.

Trial number: (first digit, second digit)				
$1:(9,3)$	$2:(8,1)$	$3:(8,8)$	$4:(9,8)$	$5:(9,8)$
$6:(4,2)$	$7:(9,5)$	$8:(5,7)$	$9:(0,4)$	$10:(7,6)$
$11:(4,2)$	$12:(8,0)$	$13:(3,8)$	$14:(3,8)$	$15:(2,5)$
$16:(1,9)$	$17:(6,7)$	$18:(3,2)$	$19:(8,6)$	$20:(7,7)$

Answer Key

1. Wrong tally 17; true wins 3; rate $\frac{3}{20}$.
2. Reuse $3/10$; independent $\frac{9}{100}$; observed $\frac{1}{5}$.
3. Missed $2, 6, 11, 12, 16, 18, 19$; corrected rate $\frac{9}{20}$.
4. Observed $\frac{9}{20}$; model $\frac{9}{20}$. They match here.
5. Reversed 1, correct 2; rate $\frac{1}{10}$.
6. About 35 wins; not guaranteed.

Step-by-Step Solutions

Follow each calculation, then check your own work.

Problem 1

1. The wrong tally adds 4 successful first digits and 13 successful second digits: $4 + 13 = 17$.

2. A trial such as $(1, 3)$ has one successful digit but does not win; both conditions are required.

3. Winning trials: $8, 13, 15$; count 3 of 20.

4. Observed rate: $3/20 = \frac{3}{20}$.

Problem 2

1. With reuse, either both pass or both fail. Both pass on just 3 of 10 labels.

2. With independent digits, multiply: $(3/10)(3/10) = \frac{9}{100}$.

3. Winning trials: $5, 6, 10, 16$; count 4 of 20.

4. Observed rate: $4/20 = \frac{1}{5}$.

Problem 3

1. The both-high rule counts 2 trials.

2. It misses trials with just one high digit: $2, 6, 11, 12, 16, 18, 19$. That adds 7 wins.

3. The corrected count is $2 + 7 = 9$.

4. Observed rate: $9/20 = \frac{9}{20}$.

Problem 4

1. Winning trials: $1, 2, 3, 7, 9, 11, 12, 16, 18$; count 9 of 20.

2. Observed rate: $9/20 = \frac{9}{20}$.

3. The model has $9 + 8 + \cdots + 1 = 45$ increasing ordered pairs out of 100, or $\frac{9}{20}$.

4. They match in this run, but a run need not equal its model.

Problem 5

1. The reversed test keeps trials 12, a count of 1.

2. Order matters: $(5, 2)$ passes the intended test but $(2, 5)$ does not.

3. Winning trials: $9, 11$; count 2 of 20.

4. Observed rate: $2/20 = \frac{1}{10}$.

Problem 6

1. Winning trials: $1, 2, 12, 13, 14, 15, 16$; count 7 of 20.

2. Observed rate: $7/20 = \frac{7}{20}$.

3. $100/20 = 5$, so multiply the count by 5: $5(7) = 35$. Do not add 80 wins.

4. The forecast uses the same rate, but later trials may differ.

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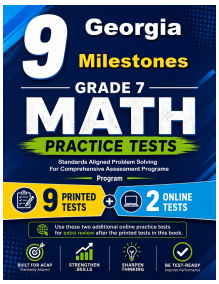

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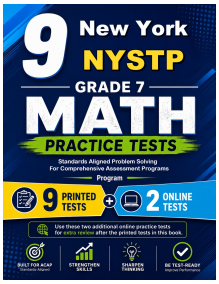

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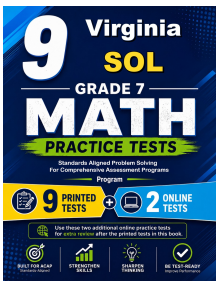

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