

Geometric Probability and Conditional Probability: practice solutions, Grade 10 – download the PDF

Written solutions to the chapter problems. Check each step, then correct yourself.

1 Spinner events



Prime numbers: 2, 3, 5, 7, so $P(A) = \frac{4}{8} = \frac{1}{2}$. Greater than 5: 6, 7, 8, so $P(B) = \frac{3}{8}$.

Both: only 7, so $P(A \cap B) = \frac{1}{8}$. Union: $\{2, 3, 5, 6, 7, 8\}$, so $P(A \cup B) = \frac{6}{8} = \frac{3}{4}$. Check:

$$\frac{4}{8} + \frac{3}{8} - \frac{1}{8} = \frac{6}{8}.$$

$$P(A^c) = 1 - \frac{1}{2} = \frac{1}{2}.$$

2 Two coins



(a) $S = \{HH, HT, TH, TT\}$: 4 equally likely outcomes.

(b) Exactly one head: HT and TH , so $\frac{2}{4} = \frac{1}{2}$.

(c) At least one head: all but TT , so $\frac{3}{4}$.

3 A rope cut at random



The favorable positions are the first 5 ft and the last 5 ft: $5 + 5 = 10$ ft out of 30 ft.

$$P = \frac{10}{30} = \frac{1}{3}.$$

4 Rainy weekend



The complement rule gives $1 - 0.35 = 0.65$.

“Rains or does not rain” is certain, so its probability is $0.35 + 0.65 = 1$.

5 Lunch menu



(a) By the Fundamental Counting Principle, $4 \cdot 3 \cdot 2 = 24$ meals.

(b) With the chicken sandwich fixed there are $1 \cdot 3 \cdot 2 = 6$ meals, so $P = \frac{6}{24} = \frac{1}{4}$.

6 True or false: adding probabilities



False. There are 13 hearts and 4 kings, but the king of hearts is in both events. So

$$P(A \cup B) = \frac{13 + 4 - 1}{52} = \frac{16}{52}, \text{ not } \frac{17}{52}.$$

The formula without subtraction works only for mutually exclusive events.

7 Books on a shelf



(a) $5! = 120$.

(b) Treat the two books as one block: $4!$ arrangements of the 4 objects, times 2 orders inside the block, so $4! \cdot 2 = 48$.

The probability of a random arrangement having them together is $\frac{48}{120} = \frac{2}{5}$.

8

Dartboard with a circle

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Circle area: $\pi \cdot 6^2 = 36\pi$. Square area: $16^2 = 256$.

$$P = \frac{36\pi}{256} = \frac{9\pi}{64} \approx 0.442.$$

9

Soccer and basketball

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(a) $22 + 15 - 7 = 30$ play at least one, so $\frac{30}{40} = \frac{3}{4}$.

(b) $40 - 30 = 10$, so $\frac{10}{40} = \frac{1}{4}$.

(c) $22 - 7 = 15$, so $\frac{15}{40} = \frac{3}{8}$.

10

Independent events

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$$P(A \cap B) = 0.4 \cdot 0.5 = 0.2.$$

$$P(A \cup B) = 0.4 + 0.5 - 0.2 = 0.7.$$

Neither: $1 - 0.7 = 0.3$. Check: $0.6 \cdot 0.5 = 0.3$, because complements of independent events are independent.

11

Pet owners

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Dog owners: $8 + 17 = 25$. Cat owners: $8 + 12 = 20$.

(a) $P(\text{cat} \mid \text{dog}) = \frac{8}{25} = 0.32.$

(b) $P(\text{dog} \mid \text{cat}) = \frac{8}{20} = 0.4.$

(c) $P(\text{cat}) = \frac{20}{50} = 0.4$, which differs from **0.32**. The events are not independent.

12 Team or roles



(a) Order does not matter: ${}_{10}C_4 = \frac{10 \cdot 9 \cdot 8 \cdot 7}{4!} = \frac{5040}{24} = 210$.

(b) Order matters: ${}_{10}P_4 = 10 \cdot 9 \cdot 8 \cdot 7 = 5040$.

Each team of 4 can be assigned the 4 roles in $4! = 24$ ways, and $210 \cdot 24 = 5040$.

13 Flower bed in a garden



Triangle area: $\frac{1}{2} \cdot 15 \cdot 8 = 60 \text{ ft}^2$. Garden area: $30 \cdot 20 = 600 \text{ ft}^2$.

$P(\text{flower bed}) = \frac{60}{600} = \frac{1}{10}$ and $P(\text{not}) = 1 - \frac{1}{10} = \frac{9}{10}$.

14 Two dice



There are $6 \cdot 6 = 36$ outcomes.

(a) Sum 9: $(3, 6), (4, 5), (5, 4), (6, 3)$, so $\frac{4}{36} = \frac{1}{9}$.

(b) Sum at most 4: $(1, 1), (1, 2), (2, 1), (1, 3), (3, 1), (2, 2)$, so $\frac{6}{36} = \frac{1}{6}$.

15 Given the sum is 8



Sum 8: $(2, 6), (3, 5), (4, 4), (5, 3), (6, 2)$, 5 outcomes. Those with a 6: $(2, 6), (6, 2)$, 2 outcomes.

$P = \frac{2/36}{5/36} = \frac{2}{5}$.

16 Marbles without replacement

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(a) $P = \frac{5}{8} \cdot \frac{4}{7} = \frac{20}{56} = \frac{5}{14}$.

(b) After one red is removed, 4 of the 7 marbles are red: $\frac{4}{7}$.

(c) Red then blue: $\frac{5}{8} \cdot \frac{3}{7} = \frac{15}{56}$. Blue then red: $\frac{3}{8} \cdot \frac{5}{7} = \frac{15}{56}$. Total $\frac{30}{56} = \frac{15}{28}$.

17 Subscribers and age

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Subscribers: $45 + 30 = 75$, so $P(\text{sub}) = \frac{75}{200} = 0.375$.

First way: $P(\text{sub} \mid \text{under } 30) = \frac{45}{120} = 0.375 = P(\text{sub})$.

Second way: $P(\text{sub} \cap \text{under } 30) = \frac{45}{200} = 0.225$ and
 $P(\text{sub}) \cdot P(\text{under } 30) = 0.375 \cdot 0.6 = 0.225$.

The two numbers match, so the events are independent.

18 Photo lineup

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(a) Glue Mia and Leo into one block: $5! = 120$ arrangements, times 2 orders inside the block, so **240**.

(b) There are $6! = 720$ lineups in all, so $P = \frac{240}{720} = \frac{1}{3}$.

19 Committee probabilities

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Total committees: ${}_9C_4 = 126$.

(a) ${}_5C_2 \cdot {}_4C_2 = 10 \cdot 6 = 60$, so $P = \frac{60}{126} = \frac{10}{21}$.

(b) ${}_5C_4 = 5$, so $P = \frac{5}{126}$.

20 Meeting problem



Let x and y be the arrival times in minutes. They meet when $|x - y| \leq 15$. The sample space is the square of area $60^2 = 3600$.

The failure region is two right triangles with legs 45, each of area $\frac{1}{2} \cdot 45^2 = 1012.5$, so 2025 in all.

$$P(\text{meet}) = 1 - \frac{2025}{3600} = 1 - \frac{9}{16} = \frac{7}{16} = 0.4375.$$

21 Two machines



(a) $P(D) = 0.6 \cdot 0.02 + 0.4 \cdot 0.05 = 0.012 + 0.020 = 0.032$.

(b) $P(B | D) = \frac{P(B \cap D)}{P(D)} = \frac{0.020}{0.032} = 0.625 = \frac{5}{8}$.

So even though B makes fewer parts, it accounts for 62.5% of the defective ones.



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