

PROBABILITY & STATISTICS PACKET

ANSWER KEY

Lesson 1 — Introduction to Probability

Basic Practice

1. Bag: 4 red, 3 blue, 5 green (total = 12)

- a) $P(\text{red}) = \frac{4}{12} = \frac{1}{3} \approx 0.333 \approx 33.3\%$ b) $P(\text{blue}) = \frac{3}{12} = \frac{1}{4} = 0.25 = 25\%$ c) $P(\text{green}) = \frac{5}{12} \approx 0.417 \approx 41.7\%$
d) $P(\text{not red}) = \frac{8}{12} = \frac{2}{3} \approx 0.667 \approx 66.7\%$ e) $P(\text{red or blue}) = \frac{7}{12} \approx 0.583 \approx 58.3\%$ f) $P(\text{purple}) = 0$

2. Standard deck of 52 cards

- a) $P(\text{heart}) = \frac{13}{52} = \frac{1}{4} = 0.25 = 25\%$ b) $P(\text{face card}) = \frac{12}{52} = \frac{3}{13} \approx 0.231 \approx 23.1\%$ c) $P(\text{red card}) = \frac{26}{52} = \frac{1}{2} = 0.5 = 50\%$
d) $P(\text{ace}) = \frac{4}{52} = \frac{1}{13} \approx 0.077 \approx 7.7\%$ e) $P(\text{red ace}) = \frac{2}{52} = \frac{1}{26} \approx 0.038 \approx 3.8\%$ f) $P(\text{not a heart}) = \frac{39}{52} = \frac{3}{4} = 0.75 = 75\%$

3. Word: MATHEMATICS (total = 11 letters: M×2, A×2, T×2, H, E, I, C, S)

- a) $P(M) = \frac{2}{11} \approx 0.182 \approx 18.2\%$ b) $P(\text{vowel: A,E,I}) = \frac{4}{11} \approx 0.364 \approx 36.4\%$
c) $P(\text{consonant}) = \frac{7}{11} \approx 0.636 \approx 63.6\%$ d) $P(T) = \frac{2}{11} \approx 0.182 \approx 18.2\%$

M&M Activity — Discussion

Discussion Answers (sample responses)

- Answers vary. Students should note whether experimental \approx theoretical, and explain differences due to small sample size.
- Mars distribution: Brown 30%, Yellow 20%, Red 20%, Orange 10%, Green 10%, Blue 10%. Class data typically approximates this with larger samples.
- Sample: In a bag of 50, expect Brown \approx 15, Yellow \approx 10, Red \approx 10, Orange \approx 5, Green \approx 5, Blue \approx 5. Multiply 50 \times each theoretical probability.

Lesson 2 — Geometric Probability

Part A — Field, Shed, and Tree

Field = $27 \times 15 = 405$ sq ft | Shed = $5 \times 7 = 35$ sq ft | Tree: $r = 3$ ft $\rightarrow A = \pi(3^2) \approx 28.27$ sq ft

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|---|---|---|
| 1. Area of field = 405 sq ft | 2. Area of shed = 35 sq ft | 3. Area of tree = $\pi(3^2) \approx 28.27$ sq ft |
| 4. P(hit shed) = $35/405 \approx 8.6\%$ | 5. P(not shed) = $370/405 \approx 91.4\%$ | 6. P(miss both) = $(405-35-28.27)/405 \approx 84.6\%$ |

Part B — Dartboard

Radii: $A=2, B=4, C=6, D=10$ | Corkboard = $24 \times 30 = 720$ sq in

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| 7. Area A = $\pi(2^2) \approx 12.57$ sq in | 8. Ring B = $\pi(4^2) - \pi(2^2) \approx 37.70$ sq in | 9. Ring C = $\pi(6^2) - \pi(4^2) \approx 62.83$ sq in |
| 10. Ring D = $\pi(10^2) - \pi(6^2) \approx 201.06$ sq in | 11. Corkboard = $2 \text{ ft} \times 30 \text{ in} = 24 \times 30 = 720$ sq in | 12. P(any circle) = $\pi(10^2)/720 \approx 43.6\%$ |
| 13. P(ring C or D) = $(62.83+201.06)/720 \approx 36.6\%$ | 14. P(bull's-eye A) = $12.57/720 \approx 1.7\%$ | 15. P(ring C only) = $62.83/720 \approx 8.7\%$ |

Part C — Number Line

$H=9.0, J=9.1, K=9.2, L=9.5, M=9.7, N=9.8, P=10.9, Q=11.0, R=11.2$

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| 16. P(J to P on HR) = $(10.9-9.1)/(11.2-9.0) = 1.8/2.2 \approx 81.8\%$ | 17. P(N to K on HR) = reversed: $P(K \text{ to } N) = (9.8-9.2)/2.2 \approx 27.3\%$ |
| 18. P(J to K on MN) = J, K outside MN range $\rightarrow 0\%$ | 19. P(M to P on LQ) = $(10.9-9.7)/(11.0-9.5) = 1.2/1.5 = 80.0\%$ |
| 20. 25% on JR = JR = 9.1 to 11.2; 25% = 0.525 units. e.g. J to L | 21. 50% on JQ = JQ = 9.1 to 11.0; 50% = 0.95 units. e.g. J to M |

Part D — Inscribed Figures

Square = $12 \times 12 = 144$ | Circle: $r=6, A=\pi(36) \approx 113.10$ | Rectangle = $4 \times 12 = 48$ | Triangle = $\frac{1}{2}(4)(5) = 10$

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| 22. P(triangle only) = $10/144 \approx 6.9\%$ | 23. P(rect, not triangle) = $(48-10)/144 = 38/144 \approx 26.4\%$ |
| 24. P(circle, not rect) = $(113.10-48)/144 \approx 45.2\%$ | 25. P(square, not circle) = $(144-113.10)/144 \approx 21.5\%$ |

Lesson 3 — Compound Events

Part A — Independent Events

1. $(1/2)^3 = 1/8 = 12.5\%$

2. $1/2 \times 1/6 = 1/12 \approx 8.3\%$

3. $3/6 \times 3/6 = 1/4 = 25\%$

4. $2/8 \times 2/8 = 1/16 = 6.25\%$

5. $5/8 \times 3/8 = 15/64 \approx 23.4\%$

6. $0.3 \times 0.5 = 0.15 = 15\%$

Part B — Dependent Events

7. $3/8 \times 2/7 = 6/56 = 3/28 \approx 10.7\%$

8. $5/8 \times 3/7 = 15/56 \approx 26.8\%$

9. $3/7 \times 2/6 = 6/42 = 1/7 \approx 14.3\%$

10. $4/7 \times 3/6 = 12/42 = 2/7 \approx 28.6\%$

11. $4/52 \times 3/51 = 12/2652 = 1/221 \approx 0.45\%$

12. $6/10 \times 4/9 = 24/90 = 4/15 \approx 26.7\%$

Lesson 4 — Two-Way Tables & Addition Rule

Part A — Jefferson High (sports/grades table)

1. $4/63 \approx 6.3\%$

2. $2/63 \approx 3.2\%$

3. $20/63 \approx 31.7\%$

4. $24/63 \approx 38.1\%$

5. $(19+24-4)/63 = 39/63 \approx 61.9\%$

6. $22/39 \approx 56.4\%$

Part A — Sports by Grade (440 students)

7. $5/440 \approx 1.1\%$

8. $120/440 = 3/11 \approx 27.3\%$

9. $50/440 = 5/44 \approx 11.4\%$

10. $(85+272-50)/440 = 307/440 \approx 69.8\%$

11. $20/135 \approx 14.8\%$

12. $(120+135)/440 = 255/440 \approx 58.0\%$

Part B — Venn / OR Problems

Problem 13. (100 students: 44 male, 54 in favor; of those in favor 20 female → 34 male in favor)

a) $P(\text{male \& NOT in favor}) = (44-34)/100 = 10/100 = 10\%$

b) $P(\text{male OR in favor}) = 44/100 + 54/100 - 34/100 = 64/100 = 64\%$

c) $P(\text{female OR male}) = 100/100 = 100\%$

Problem 14. (100 students: 54 favor 4-day week W, 27 want business B; 18 in both)

a) $P(W \text{ and } B) = 18/100 = 18\%$

b) $P(W \text{ but not } B) = (54-18)/100 = 36/100 = 36\%$

c) $P(\text{neither}) = (100-54-27+18)/100 = 37/100 = 37\%$

Quiz Review — Lessons 3 & 4

1. $(1/2)^3 = 1/8 = 12.5\%$

2. $3/6 \times 3/6 = 1/4 = 25\%$

3. $3/8 \times 2/7 = 6/56 = 3/28 \approx 10.7\%$

4. $5/8 \times 3/7 = 15/56 \approx 26.8\%$

5. $11/25 = 0.44 = 44\%$ (7+4=11 bought out of 25)

6. $9/25 = 0.36 = 36\%$ (women who didn't buy)

7. B — 0.25 ($1/2 \times 3/6 = 3/12 = 1/4$)

8. B — 0.25 ($1/2 \times 3/6 = 1/4$)

Lesson 5 — Statistics

Part A — Measures of Center and Spread

Dataset: 3, 7, 5, 4, 6, 3, 8, 4 → Sorted: 3, 3, 4, 4, 5, 6, 7, 8

- Sorted: **3, 3, 4, 4, 5, 6, 7, 8**
- Mean: $(3+3+4+4+5+6+7+8)/8 = 40/8 = 5$
- Median: $(4+5)/2 = 4.5$
- Mode: **3 and 4 (both appear twice)**
- Range: $8 - 3 = 5$
- Q1: $(3+4)/2 = 3.5$
- Q3: $(6+7)/2 = 6.5$
- IQR: $6.5 - 3.5 = 3$
- Outliers: **None — all within $1.5 \times \text{IQR}$ of Q1/Q3**

Part B — Standard Deviation

10. Dataset: 3,7,5,4,6,3,8,4 Mean = 5

x	x - mean	(x - mean) ²	
3	-2	4	
3	-2	4	
4	-1	1	
4	-1	1	
5	0	0	
6	1	1	
7	2	4	
8	3	9	
Sum:	0	24	$\sigma = \sqrt{(24/7)} \approx 1.85$

Part C — Frequency Distribution & Normal Distribution

12. Normal distribution: yes if bell-shaped; no if skewed or flat. Sample size affects shape — larger samples better approximate normal.

13. Normal distribution: mean = 75, $\sigma = 8$

a) 1 SD range: **67 to 83**

b) 2 SD range: **59 to 91**

c) Students between 67–83: **68% of 200 \approx 136 students**

d) Students above 91: **$(100-95)/2 = 2.5%$ of 200 \approx 5 students**

14. **64 to 76 = $\mu \pm 2\sigma$ → 95% of adult males**