

Probability Rules and Random Variables

Grade 12 – AP Statistics math · Worksheet Answer Key · Standards: AP Statistics Unit 2 (2026-27)

The answer key writes out every probability calculation, including the denominators used for conditional probabilities. Check that each answer is between 0 and 1 and that interpretations mention the context.

Standards: AP Statistics Unit 2 (2026-27) · **Level:** Grade 12 AP Statistics

Problem 1 Complement Rule

(a) $1 - 0.08 = 0.92$. (b) $P(\text{neither late}) = 0.92 \times 0.92 = 0.8464$, so $P(\text{at least one late}) = 1 - 0.8464 = 0.1536$.

(a) 0.92; (b) 0.1536

Problem 2 Marginal Relative Frequencies

(a) $105/250 = 0.42$. (b) $80/250 = 0.32$. (c) $90/250 = 0.36$.

(a) 0.42, (b) 0.32, (c) 0.36

Problem 3 Joint and Conditional Frequencies

(a) $35/250 = 0.14$. (b) Among the 80 11th graders, 42 are members: $42/80 = 0.525$. (c) Among the 105 members, 42 are in Grade 11: $42/105 = 0.40$.

(a) 0.14, (b) 0.525, (c) 0.40

Problem 4 Exclusive Events

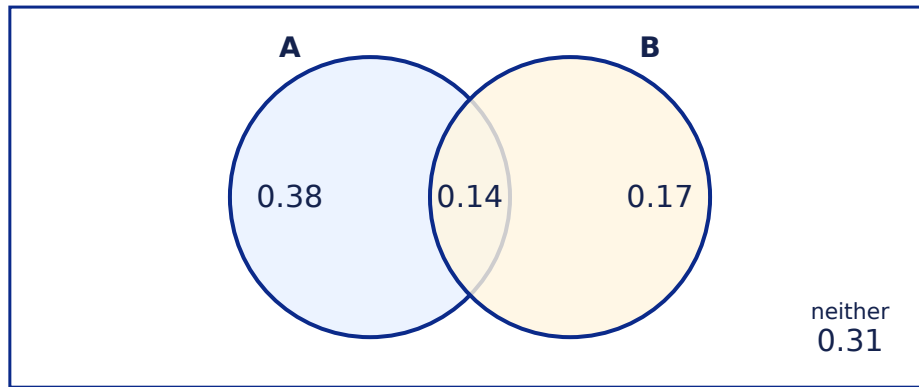
The events are mutually exclusive, so $P(\text{pizza or sandwich}) = 0.35 + 0.25 = 0.60$. If they were independent, $P(\text{both})$ would be $0.35 \times 0.25 = 0.0875$, but it is 0.

0.60; not independent

Problem 5 Addition Rule with Overlap

$P(A \text{ or } B) = 0.52 + 0.31 - 0.14 = 0.69$. Neither: $1 - 0.69 = 0.31$. The regions are 0.38 (A only),

0.14, 0.17 (*B* only) and 0.31.



Completed diagram.

$P(A \text{ or } B) = 0.69$; $P(\text{neither}) = 0.31$

Problem 6 Conditional Probability from Counts

Given an electric bike owner, the probability of owning a car is $90/120 = 0.75$. For a random adult from all 300, $P(\text{electric and car}) = 90/300 = 0.30$.

0.75; 0.30

Problem 7 Testing Independence with a Table

$P(\text{glasses} \mid \text{left}) = 12/40 = 0.30$. $P(\text{glasses} \mid \text{right}) = 48/160 = 0.30$. Overall $P(\text{glasses}) = 60/200 = 0.30$. All three are equal, so knowing handedness does not change the probability of wearing glasses.

Yes, independent

Problem 8 Multiplication Rule for Free Throws

(a) $0.72 \times 0.72 \times 0.72 = 0.3732$. (b) $0.28 \times 0.72 \times 0.72 = 0.1452$.

(a) 0.373; (b) 0.145

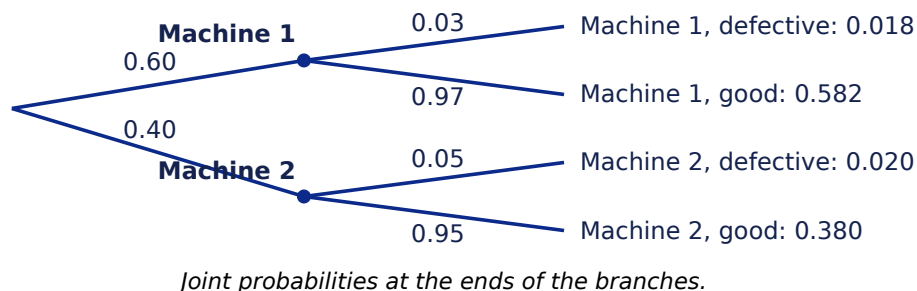
Problem 9 Tree Diagram for Defects

$P(\text{defective}) = 0.60(0.03) + 0.40(0.05) = 0.018 + 0.020 = 0.038$.

0.038

Problem 10 Reverse Conditional Probability

$P(\text{Machine 1} \mid \text{defective}) = P(\text{Machine 1 and defective})/P(\text{defective}) = 0.018/0.038 = 0.4737$.



≈ 0.474

Problem 11 Designing a Simulation

Each guess is right with probability $1/5$, so let digits 0 and 1 mean a correct answer and digits 2 through 9 an incorrect answer. Four digits make one quiz. The numbers correct in the 8 quizzes are 0, 1, 0, 1, 1, 0, 2, 0. At least 2 correct occurred in 1 of 8 quizzes, so the estimate is $1/8 = 0.125$. (More than 8 trials would be used in real studies.)

Digits 0-1 = correct; estimate = $1/8 = 0.125$

Problem 12 Using Simulation Results

At least 4: $(60 + 31)/200 = 0.455$. At most 2: $(2 + 11 + 34)/200 = 0.235$.

≈ 0.455 ; ≈ 0.235

Problem 13 Finding a Missing Probability

The probabilities sum to 1: $k = 1 - (0.18 + 0.34 + 0.27 + 0.06) = 0.15$. Then $P(X \geq 2) = 0.27 + 0.15 + 0.06 = 0.48$.

$k = 0.15$; $P(X \geq 2) = 0.48$

Problem 14 Mean of a Random Variable

$\mu = 0(0.18) + 1(0.34) + 2(0.27) + 3(0.15) + 4(0.06) = 1.57$. Over many households, the average number of pets is about 1.57.

$\mu = 1.57$ pets per household

Problem 15 Standard Deviation of a Random Variable

Using $\mu = 1.57$: variance = $(0 - 1.57)^2(0.18) + (1 - 1.57)^2(0.34) + (2 - 1.57)^2(0.27) + (3 - 1.57)^2(0.15) + (4 - 1.57)^2(0.06) = 1.2651$. So $\sigma = \sqrt{1.2651} \approx 1.125$. A typical household differs from the mean by about 1.12 pets.

$\sigma \approx 1.12$ pets

Problem 16 Probability Histogram

$P(X \geq 4) = 0.20 + 0.15 = 0.35$. Mean = $1(0.10) + 2(0.25) + 3(0.30) + 4(0.20) + 5(0.15) = 3.05$.

0.35; mean = 3.05 tickets

Problem 17 Expected Value of a Game

Expected prize = $0(0.7) + 4(0.2) + 10(0.1) = 1.80$. Expected net gain = $1.80 - 3 = -1.20$, that is a loss of 1.20. In the long run a player loses an average of \$1.20 per play.

Expected net gain = -\$1.20 per play

Problem 18 Sampling without Replacement

(a) $(105/250)(104/249) = 0.1754$. (b) senior then non-senior plus non-senior then senior: $2 \times (105/250)(145/249) = 0.4892$.

(a) 0.175; (b) 0.489

Problem 19 At Least One Success

(a) $P(\text{none buy}) = 0.85^5 = 0.4437$, so $P(\text{at least one}) = 1 - 0.4437 = 0.5563$. (b) The first two do not buy and the third does: $0.85 \times 0.85 \times 0.15 = 0.1084$.

(a) 0.556; (b) 0.108

Problem 20 Warranty Cost Distribution

$\mu = 0(0.85) + 120(0.09) + 300(0.05) + 600(0.01) = 31.80$. Variance = $(0 - 31.8)^2(0.85) + (120 - 31.8)^2(0.09) + (300 - 31.8)^2(0.05) + (600 - 31.8)^2(0.01) = 8384.76$, so $\sigma \approx 91.57$. Expected profit = $40 - 31.80 = 8.20$.

$\mu = \$31.80$, $\sigma \approx \$91.57$; expected profit \$8.20