

Precalculus · Expected Value and Decisions · Worksheet

Common Core S-MD.A.3, S-MD.A.4, S-MD.B.5 · mathovore.fr

Name: _____ Date: ____/____/____ Score: _____

These problems practice building probability distributions from theoretical and empirical probabilities (S-MD.A.3), calculating and interpreting expected values (S-MD.A.4), and weighing outcomes of decisions with expected value (S-MD.B.5). Start with valid distributions, then move through games, raffles, and spinners.

The last six problems are multi-step decisions about warranties, insurance, fundraising, and investing. Show every product in each expected value so a mistake is easy to find.

Precalculus Common Core: S-MD.A.3 · S-MD.A.4 · S-MD.B.5

Problem 1: Valid distributions

Decide whether each list could be a probability distribution for four values of X . Give a reason.

- a. 0.20, 0.35, 0.15, 0.30
- b. 0.40, 0.30, 0.20, 0.20
- c. 0.50, 0.60, -0.10, 0
- d. $\frac{1}{4}, \frac{1}{2}, \frac{1}{8}, \frac{1}{8}$

Problem 2: Find the missing probability

A random variable X takes the values 1, 2, 3, 4 with $P(1) = 0.10$, $P(2) = 0.30$, $P(4) = 0.20$.

- a. Find $P(3)$.
- b. Find $P(X \geq 3)$.

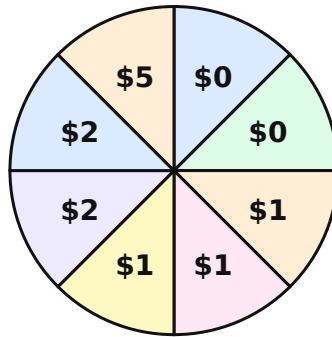
Problem 3: Distribution for three coin flips

A fair coin is flipped three times. Let X be the number of heads.

- a. List the 8 equally likely outcomes.
- b. Write the probability distribution of X .
- c. Find $P(X \geq 2)$.

Problem 4: Spinner prize distribution

Ethan's spinner has 8 equal sections with the prizes shown.



The prize in each section of the spinner.

- Write the probability distribution of the prize.
- Find the expected prize.

Problem 5: Empirical distribution from a survey

Mei asked 40 classmates how many siblings they have: 8 said 0, 16 said 1, 10 said 2, and 6 said 3.

- Write the empirical probability distribution.
- Find the probability that a randomly chosen classmate has at least 2 siblings.

Problem 6: Expected value from a table

The number of siblings X has this distribution: $P(0)=0.20$, $P(1)=0.40$, $P(2)=0.25$, $P(3)=0.15$. Find $E(X)$ and explain what it means.

Problem 7: Fair die and unfair die

- Find the expected value of one roll of a fair six-sided die.
- A die has faces 1, 1, 2, 3, 3, 6. Find the expected value of one roll.

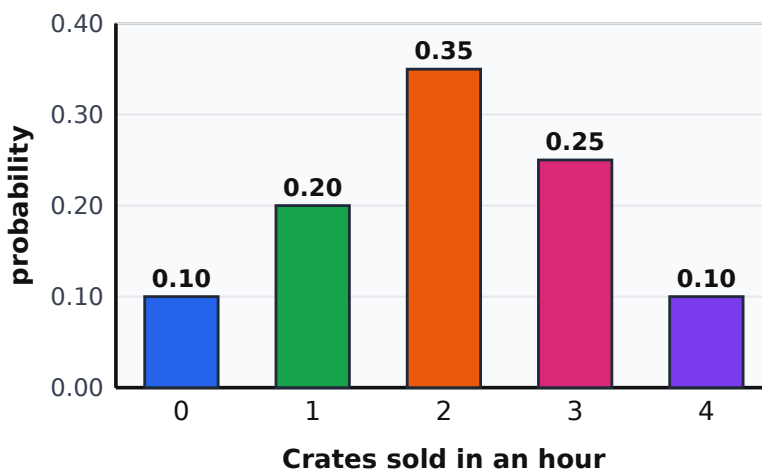
Problem 8: Raffle tickets

The drama club sells 200 raffle tickets at \$1 each. One ticket wins \$50, three tickets win \$10 each, and the rest win nothing.

- Find the expected prize for one ticket.
- Find the expected net result for one ticket after paying \$1.
- Find the expected net result for a buyer of 25 tickets.

Problem 9: Farmers market stall

Diego's stall sells crates of peaches. The graph shows the probability of selling each number of crates in one hour.



Probability distribution of crates sold per hour.

- Find the expected number of crates sold in an hour.
- Each crate sells for \$12. Find the expected revenue per hour.

Problem 10: Bike insurance

Liam's bike is worth \$400. The chance it is stolen this year is 5%. Insurance that replaces the bike costs \$25 for the year.

- Find the expected loss without insurance.
- Compare it with the cost of insurance.
- Give a reason Liam might still buy the insurance.

Problem 11: Is the dice game fair?

Noah pays \$4 to roll a fair die once and receives as many dollars as the number rolled.

- Find his expected net result per game.
- What entry fee would make the game fair?

Problem 12: Fair price of a game

A game pays \$10 with probability 0.1, pays \$2 with probability 0.4, and pays nothing otherwise.

- Find the probability of winning nothing.

- b. Find the entry fee that makes the game fair.

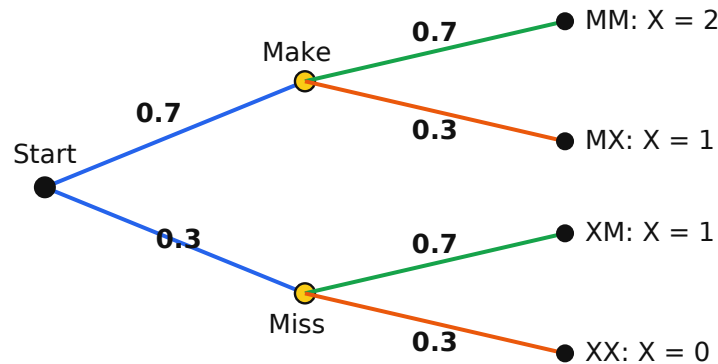
Problem 13: Betting on a roulette wheel

A wheel has 38 equally likely slots. A \$1 bet on one number pays a profit of \$35 if the ball lands there; otherwise the \$1 is lost.

- Find the expected net result of one bet as a fraction and as a decimal rounded to the nearest thousandth of a dollar.
- Predict the result of 1,000 such bets.

Problem 14: Two free throws

Jamal makes each free throw with probability 0.7, and the shots are independent. Let X be the number of shots he makes in two tries. The tree shows the possible results.



Each branch is labeled with its probability.

- Find the probability of each outcome at the end of the tree.
- Write the distribution of X .
- Find $E(X)$.

Problem 15: Guessing on a quiz

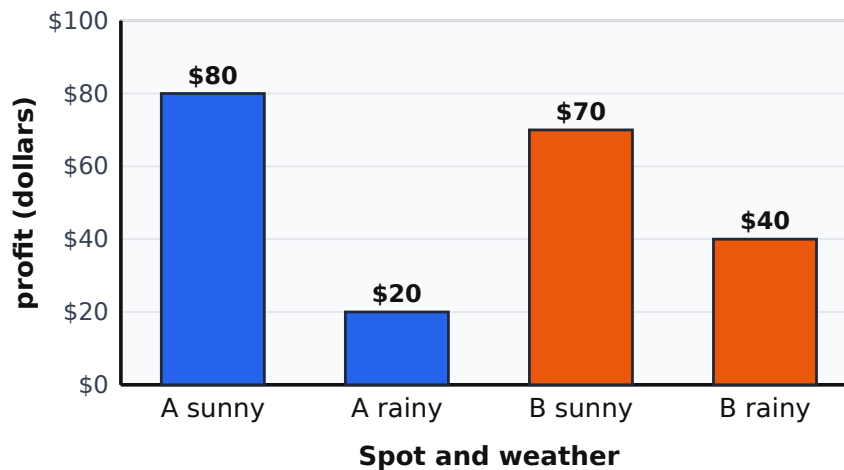
A quiz question has 4 answer choices. A correct answer earns 4 points and a wrong answer loses 1 point. Aisha guesses randomly.

- Find the expected score for one guess.
- What penalty for a wrong answer would make the expected score of a guess equal to 0?

Problem 16: Choosing a lemonade stand spot

Diego picks one of two spots. The chance of a sunny day is 0.6 and the chance of a rainy day

is 0.4. The graph shows the profit at each spot.



Profit for each spot and weather.

- Find the expected profit at each spot.
- Which spot should Diego choose? Explain.

Problem 17: Tablet warranty

A \$300 tablet has a \$50 warranty that covers any repair. There is a 12% chance the tablet needs a \$250 repair.

- Find the expected repair cost without the warranty.
- Should the buyer purchase the warranty based on expected value?
- For what repair probability would the warranty cost the same as the expected repair cost?

Problem 18: Laptop warranty break-even

A laptop warranty costs \$120. The chance of a failure is 18%.

- If a failure costs \$600 to repair, compare the expected repair cost with the warranty price.
- Find the failure probability that makes the two equal for a \$600 repair.
- If a failure instead means buying a \$900 replacement, does the warranty become worthwhile?

Problem 19: Insurance company profit

An insurer sells a policy for \$450. The chance of a \$25,000 claim on one policy is 1%, and no other claims are paid.

- Find the expected payout per policy.
- Find the expected profit per policy.
- Find the expected profit on 10,000 policies.

Problem 20: School fundraiser lottery

Aisha's school sells 300 tickets at \$5. Prizes: one \$400 prize, four \$50 prizes, and ten \$10 prizes.

- Find the expected prize per ticket as a decimal rounded to the nearest cent.
- Find the expected net result for a ticket buyer.
- How much money does the school keep after paying all prizes?

Problem 21: Empirical versus theoretical

Liam's spinner has four equal sections numbered 1 to 4. He spun it 50 times and got 1 eleven times, 2 fourteen times, 3 twelve times, and 4 thirteen times.

- Find the theoretical expected value.
- Find the mean of the 50 results.
- Explain why the two answers differ slightly.

Problem 22: Drawing two marbles

A bag holds 3 red and 2 blue marbles. Sofia draws two marbles without replacement. Let X be the number of red marbles drawn.



3 red (R) and 2 blue (B)

The contents of the bag.

- Write the distribution of X .
- Find $E(X)$.

Problem 23: A risky investment

Ethan puts \$10,000 into a project. The net gain is \$40,000 with probability 0.30, \$5,000 with probability 0.50, and a loss of \$10,000 with probability 0.20. A savings plan would give a sure gain of \$3,000.

- Find the expected net gain of the project.
- Compare it with the savings plan.

- c. Give one reason a cautious person might choose the savings plan.

Problem 24: Food truck decision

Sofia's food truck can enter a festival or use its regular spot. The festival booth costs \$200 and brings revenue of \$900 with probability 0.4, \$500 with probability 0.4, or \$200 with probability 0.2. The regular spot gives a sure \$350 of revenue and no fee.

- a. Find the expected net result at the festival.
- b. Which option has the greater expected value, and by how much?
- c. What is the probability that the festival nets \$0?