

Choices by Chance

Use expected value to compare decisions.

HIGH SCHOOL • HSS-MD.B

CCSS.Math.Content.HSS-MD.B "Use probability to evaluate outcomes of decisions"

NAME _____

DATE _____

EXPECTED VALUE

Use expected value to predict the average result of a choice over many repeats. Multiply each outcome by its probability, add the results, then subtract any cost to compare net values.

WORKED EXAMPLE

A game pays \$51 with probability $\frac{2}{17}$ and \$0 otherwise. It costs \$5 to play. Should you play?

1. Expected payout = $(\frac{2}{17}) \times 51 + (\frac{15}{17}) \times 0$.

2. Expected payout = \$6.

3. Expected net = \$6 - \$5 = \$1.

Answer: Yes. The expected net gain is \$1 per play.

PRACTICE 6 problems

- 1** A game costs \$8. You win \$14 with probability $\frac{3}{7}$ and otherwise win no prize. What is the expected net gain or loss per play?

ANSWER _____

- 2** A ticket costs \$7. It has probability $\frac{4}{9}$ of winning \$18 and otherwise wins no prize. What is the expected net gain or loss?

ANSWER _____

- 3** Option A pays \$16 with probability $\frac{7}{8}$. Option B pays \$13 for sure. Which option has the greater expected payout?

ANSWER _____

- 4** A prize has probability $\frac{9}{11}$ of paying \$22 and otherwise pays no prize. What is the expected payout?

ANSWER _____

- 5** Option A has probability $\frac{3}{4}$ of paying \$28 and otherwise pays no prize. Option B pays \$19 for sure. Which option has the greater expected payout?

ANSWER _____

- 6** A game costs \$9. It has probability $\frac{4}{11}$ of paying \$33 and otherwise pays no prize. What is the expected net gain or loss per play?

ANSWER _____

APPLY IT Show your work

- 1** You are choosing a plan for selling phone charms at a school event. Plan A costs \$18 for supplies and has probability $\frac{7}{10}$ of earning \$40 in sales, with no sales otherwise. Plan B costs \$11 and guarantees \$23 in sales. Which plan has the greater expected profit, and by how much?

WORK SPACE

ANSWER _____

- 2** You can enter a gaming tournament for \$13. You have probability $\frac{4}{9}$ of winning a \$45 prize and otherwise win no prize. Instead, you could tutor for a guaranteed \$11. Which choice has the greater expected net amount, and by how much?

WORK SPACE

ANSWER _____

CHALLENGE One step up

CHALLENGE

Your phone has probability $\frac{7}{12}$ of needing a \$48 repair this year, with no repair cost otherwise. A protection plan costs \$25 and covers the repair. Which choice has the lower expected cost? Explain your reasoning.

PART 1 • PRACTICE

#	PROBLEM	ANSWER
1	A game costs \$8. You win \$14 with probability $\frac{3}{7}$ and otherwise win no prize. What is the expected net gain or loss per play?	Expected net loss: \$2
2	A ticket costs \$7. It has probability $\frac{4}{9}$ of winning \$18 and otherwise wins no prize. What is the expected net gain or loss?	Expected net gain: \$1
3	Option A pays \$16 with probability $\frac{7}{8}$. Option B pays \$13 for sure. Which option has the greater expected payout?	Option A, with an expected payout of \$14.
4	A prize has probability $\frac{9}{11}$ of paying \$22 and otherwise pays no prize. What is the expected payout?	\$18
5	Option A has probability $\frac{3}{4}$ of paying \$28 and otherwise pays no prize. Option B pays \$19 for sure. Which option has the greater expected payout?	Option A, with an expected payout of \$21.
6	A game costs \$9. It has probability $\frac{4}{11}$ of paying \$33 and otherwise pays no prize. What is the expected net gain or loss per play?	Expected net gain: \$3

PART 2 • APPLY IT

- Plan B has the greater expected profit by \$2.** Plan A has expected profit $(\frac{7}{10} \times 40) - 18 = 10$. Plan B has profit $23 - 11 = 12$.
- Tutoring has the greater expected net amount by \$4.** The tournament has expected net amount $(\frac{4}{9} \times 45) - 13 = 7$. Tutoring earns \$11.

CHALLENGE

Buy the protection plan. Without it, the expected repair cost is $(\frac{7}{12}) \times 48 = \28 , which is \$3 more than the \$25 plan.

Accept correct expected values written as a gain, loss, profit, payout, or cost when the meaning is clear. For comparison items, students should identify the choice and support it with the correct expected values.