

Expected Value Lab

Find the long-run average of a random variable.

HIGH SCHOOL • HSS-MD.A.2

CCSS.Math.Content.HSS-MD.A.2 "(+) Calculate the expected value of a random variable; interpret it as the mean of the probability distribution."

NAME _____

DATE _____

EXPECTED VALUE

Multiply each possible value of a random variable by its probability. Then add the products. The expected value is the mean of the probability distribution, so it describes a long-run average, not necessarily one result you will get.

WORKED EXAMPLE

A random variable X has values 11, 17, and 23 with probabilities 0.2, 0.3, and 0.5. Find $E(X)$.

- $11(0.2) = 2.2$, $17(0.3) = 5.1$, and $23(0.5) = 11.5$.
- $E(X) = 2.2 + 5.1 + 11.5$.
- $E(X) = 18.8$.

Answer: $E(X) = 18.8$

PRACTICE 6 problems

- 1** Random variable A is 0 with probability $1/8$ and 8 with probability $7/8$. Find $E(A)$.

ANSWER _____

- 2** Random variable B is -6 with probability $3/10$, 0 with probability $4/10$, and 10 with probability $3/10$. Find $E(B)$.

ANSWER _____

- 3** Random variable C is 4 with probability $1/4$, 6 with probability $1/2$, and 14 with probability $1/4$. Find $E(C)$.

ANSWER _____

- 4** Random variable D is -4 with probability $1/8$, 8 with probability $3/8$, and 16 with probability $4/8$. Find $E(D)$.

ANSWER _____

- 5** Random variable E is -10 with probability $1/4$, 0 with probability $1/2$, and 20 with probability $1/4$. Find $E(E)$.

ANSWER _____

- 6** Random variable F is 1 with probability $2/10$, 4 with probability $5/10$, and 7 with probability $3/10$. Find $E(F)$.

ANSWER _____

APPLY IT Show your work

1

At a school game night, a student-run snack booth has a net profit of -\$8 if turnout is low, \$4 if turnout is medium, and \$14 if turnout is high. The probabilities are $\frac{1}{4}$, $\frac{1}{2}$, and $\frac{1}{4}$. What is the expected net profit for the evening?

WORK SPACE

ANSWER _____

2

A robotics team enters a design contest. After materials and entry costs, the team's net funds will be -\$12 with probability $\frac{1}{5}$, \$3 with probability $\frac{1}{2}$, or \$18 with probability $\frac{3}{10}$. What is the expected net funds from entering?

WORK SPACE

ANSWER _____

CHALLENGE One step up

CHALLENGE

Two student creators are choosing a payment plan for a sponsored post. Plan A pays \$0 with probability $\frac{1}{4}$, \$8 with probability $\frac{1}{2}$, and \$16 with probability $\frac{1}{4}$. Plan B pays \$4 with probability $\frac{1}{2}$ and \$12 with probability $\frac{1}{2}$. Find the expected value of each plan. Then state which plan you would choose if you want a guaranteed minimum of \$4, and explain why.

PART 1 • PRACTICE

#	PROBLEM	ANSWER
1	Random variable A is 0 with probability $\frac{1}{8}$ and 8 with probability $\frac{7}{8}$. Find $E(A)$.	$E(A) = 7$
2	Random variable B is -6 with probability $\frac{3}{10}$, 0 with probability $\frac{4}{10}$, and 10 with probability $\frac{3}{10}$. Find $E(B)$.	$E(B) = \frac{6}{5}$
3	Random variable C is 4 with probability $\frac{1}{4}$, 6 with probability $\frac{1}{2}$, and 14 with probability $\frac{1}{4}$. Find $E(C)$.	$E(C) = \frac{15}{2}$
4	Random variable D is -4 with probability $\frac{1}{8}$, 8 with probability $\frac{3}{8}$, and 16 with probability $\frac{4}{8}$. Find $E(D)$.	$E(D) = \frac{21}{2}$
5	Random variable E is -10 with probability $\frac{1}{4}$, 0 with probability $\frac{1}{2}$, and 20 with probability $\frac{1}{4}$. Find $E(E)$.	$E(E) = \frac{5}{2}$
6	Random variable F is 1 with probability $\frac{2}{10}$, 4 with probability $\frac{5}{10}$, and 7 with probability $\frac{3}{10}$. Find $E(F)$.	$E(F) = \frac{43}{10}$

PART 2 • APPLY IT

- \$ $\frac{7}{2}$, or \$3.50** Calculate $(-8)(\frac{1}{4}) + 4(\frac{1}{2}) + 14(\frac{1}{4})$. The expected net profit is $-2 + 2 + \frac{7}{2} = \frac{7}{2}$ dollars.
- \$ $\frac{9}{2}$, or \$4.50** Calculate $(-12)(\frac{1}{5}) + 3(\frac{1}{2}) + 18(\frac{3}{10})$. The sum is $\frac{9}{2}$ dollars.

CHALLENGE

$E(A) = \$8$ and $E(B) = \$8$. Choose Plan B because its lowest possible payment is \$4, while Plan A can pay \$0.

Accept equivalent fractions, decimals, or money forms for expected values. For the challenge, accept any clear explanation that both plans have the same expected value and that Plan B guarantees at least \$4.