LESSON MAKER PRO

Expected Value Lab

Build distributions from observed results.

HIGH SCHOOL · HSS-MD.A.4

CCSS.Math.Content.HSS-MD.A.4 "(+) Develop a probability distribution for a random variable defined for a sample space in which probabilities are assigned empirically; find the expected value. For example..."

NAME _____ DATE _____

FROM DATA TO EXPECTED VALUE

For each value of X, divide its observed frequency by the total number of trials to get its empirical probability. Multiply each value by its probability, then add the products. This sum is the expected value, or long-run average.

WORKED EXAMPLE

In 20 trials, X was 11 in 4 trials, 13 in 7 trials, and 15 in 9 trials. Find E(X).

1. Total trials: 4 + 7 + 9 = 20.
2. P(X=11)=4/20, P(X=13)=7/20, and P(X=15)=9/20.
3. E(X)=11(4/20)+13(7/20)+15(9/20)=270/20.

Answer: E(X) = 27/2.

PRACTICE 4 problems

1 In 30 trials, X was 3 in 6 trials, 5 in 10 trials, and 8 in 14 trials. Find E(X).

ANSWER _____

2 In 24 trials, X was 0 in 6 trials, 1 in 12 trials, and 2 in 6 trials. Write the probability distribution and find E(X).

ANSWER _____

3 During 28 short practice drills, a player made 1 basket in 8 drills, 2 baskets in 14 drills, and 3 baskets in 6 drills. Find the expected number of baskets per drill.

ANSWER _____

4 In 25 prize-game trials, a player won 0 prizes 10 times, 1 prize 10 times, and 2 prizes 5 times. Find E(X), then predict the total prizes in 100 similar trials.

ANSWER _____

APPLY IT Show your work

1 The table shows club meetings attended last month by 24 randomly selected students. Write the empirical probability distribution, find the expected meetings per student, and predict the total meetings for 120 similar students.

CLUB MEETINGS ATTENDED

Meetings, X	Students
0	8
1	6
2	8
3	2

ANSWER _____

2 A media lab records charger checkouts by 36 randomly selected students in one week. Fourteen students checked out 0 chargers, 14 checked out 1 charger, and 8 checked out 2 chargers. Write the distribution, find E(X), and predict total checkouts for 180 similar students.

WORK SPACE

ANSWER _____

CHALLENGE One step up

Two gaming clubs survey livestreams watched last week. Club A has 12 students: 0 livestreams for 3 students, 1 for 6 students, and 2 for 3 students. Club B has 18 students: 0 for 8 students, 1 for 8 students, and 2 for 2 students. Combine the samples, find E(X), and predict the total livestreams for 60 similar students. In one sentence, explain why you should not simply average the two club means.

WORK SPACE AND ANSWER

ANSWER KEY

Expected Value Lab

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PART 1 · PRACTICE

#	PROBLEM	ANSWER
1	In 30 trials, X was 3 in 6 trials, 5 in 10 trials, and 8 in 14 trials. Find E(X).	**E(X) = 6.**
2	In 24 trials, X was 0 in 6 trials, 1 in 12 trials, and 2 in 6 trials. Write the probability distribution and find E(X).	**P(X=0)=1/4, P(X=1)=1/2, P(X=2)=1/4; E(X)=1.**
3	During 28 short practice drills, a player made 1 basket in 8 drills, 2 baskets in 14 drills, and 3 baskets in 6 drills. Find the expected number of baskets per drill.	**E(X) = 27/14 baskets per drill.**
4	In 25 prize-game trials, a player won 0 prizes 10 times, 1 prize 10 times, and 2 prizes 5 times. Find E(X), then predict the total prizes in 100 similar trials.	**E(X)=4/5 prize per trial; 80 prizes in 100 trials.**

PART 2 · APPLY IT

1. **P(X=0)=1/3, P(X=1)=1/4, P(X=2)=1/3, P(X=3)=1/12; E(X)=7/6 meetings; 140 total meetings for 120 students.** Divide each frequency by 24. Compute E(X)=(0·8+1·6+2·8+3·2)/24=7/6, then multiply 7/6 by 120.
2. **P(X=0)=7/18, P(X=1)=7/18, P(X=2)=2/9; E(X)=5/6 checkout per student; 150 total checkouts for 180 students.** Use 36 as the total to form the probabilities. The expected value is (0·14+1·14+2·8)/36=5/6, and 180(5/6)=150.

CHALLENGE

Combined P(X=0)=11/30, P(X=1)=7/15, P(X=2)=1/6; E(X)=4/5 livestream per student; 48 livestreams for 60 students. Because the samples have different sizes, all 30 observations must be combined instead of averaging the two means.

Accept equivalent fractions, decimals, or correctly simplified probability distributions. Predicted totals are expected values and may be nonwhole numbers when the given sample size does not produce a whole result.