



Objectives SWBAT define expected value and identify who comes out ahead by applying the expected value formula to basic probability problems.



What's Our Plan?

- * Notes: Expected Value
- * Practice with Expected Value

HW = #1, 2, 15, 23, 24

The **Expected Value** of a random variable is the theoretical long run average value.

Standard deviation describes the spread in the model.

Formulas:

Mean or Expected value:

Standard Deviation:

Who comes out ahead?

Casinos

Carnival

Monopoly @ McDonald's

Lottery Example:

Win 100,000 $\frac{1}{100,000}$

Win 0 $\frac{99,999}{100,000}$

$$E(X) = \mu_x = \sum x_i p_i$$

Winnings = Expected Value - cost

Examples: $E(X) = \mu_x = \sum x_i p_i$

A. Expected Value:

x	10	20	30
P(X=x)	0.3	0.5	0.2

B. Standard deviation:

$$\sigma_x = \sqrt{\sum (x_i - \mu_x)^2 p_i}$$

Find the expected value and the standard deviation for the following.

1. Grade	0	1	2	3	4
Probability	0.10	0.15	0.30	0.30	0.15

A couple plans to have children until they get a girl, but they agree that they will not have more than three children even if all are boys. (Assume boys and girls are equally likely.)

1. Create a probability model for the number of children they will have.

2. Find the expected number of children.



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Rules for adding means or standard deviations

Rule for fixed numbers



Rule for Random numbers



or



or



	Mean	SD
X	10	2
Y	20	5

Example: Find the mean and Standard Deviation

1. $2X$
2. $X - Y$
3. $X + Y$
4. $Y - 5$

Your Turn:

Find the mean and standard deviation for the following:

	Mean	SD
X	12	3
Y	22	7

1. $x-y$

2. $3x$

3. $13-y$

4. $x + y$

5. $2x - 4y$

Time to put it all together!

Expected Value Project

Your job is to calculate the expected values for the various carnival games and answer the questions

DUE AT THE END OF CLASS

Homework - Exercises ws - 1,2,3,7,15,16,23,24,25,26,31,32

1. a) 19 b) 4.2
 2. a) 1.2 b) 280
 3. a)

Amount won	\$0	\$5	\$10	\$30
$P(\text{Amount won})$	$\frac{26}{52}$	$\frac{13}{52}$	$\frac{12}{52}$	$\frac{1}{52}$

- b) \$4.13
 c) \$4 or less (answers may vary)

23. a) $\mu = 30, \sigma = 6$ b) $\mu = 26, \sigma = 5$ c) $\mu = 30, \sigma = 5.39$
 d) $\mu = -10, \sigma = 5.39$ e) $\mu = 20, \sigma = 2.83$
 24. a) $\mu = 60, \sigma = 12$ b) $\mu = 6, \sigma = 1.50$ c) $\mu = 92, \sigma = 12.37$
 d) $\mu = 68, \sigma = 12.37$ e) $\mu = 24, \sigma = 4.24$
 25. a) $\mu = 240, \sigma = 12.80$ b) $\mu = 140, \sigma = 24$
 c) $\mu = 720, \sigma = 34.18$ d) $\mu = 60, \sigma = 39.40$
 e) $\mu = 600, \sigma = 22.63$
 26. a) $\mu = 44, \sigma = 6$ b) $\mu = 240, \sigma = 36$ c) $\mu = 32, \sigma = 4.2$
 d) $\mu = 20, \sigma = 19.21$ e) $\mu = 240, \sigma = 20.78$
 31. a) There will be many gains of \$150 with a few large losses.
 b) $\mu = \$300, \sigma = \8485.28
 c) $\mu = \$1,500,000, \sigma = \$600,000$
 d) Yes. \$0 is 2.5 SDs below the mean for 10,000 policies.
 e) Losses are independent of each other. A major catastrophe with many policies in an area would violate the assumption.
 32. a) Gamblers lose a relatively small amount most of the time, but there are a few large payouts.
 b) $\mu = \$0.40, \sigma = \268.33
 c) $\mu = \$80.00, \sigma = 3794.73$
 d) If the machine is played only 1000 times a day, the chance of being profitable will be slightly more than 50%, since \$80 is about 0.02 SDs above 0. But if the casino has many slot machines, the chances of being profitable will go up.

7. \$27,000

15. a) 1.7 b) 0.9
 16. a) 2.25 b) 1.26

A farmer has 100 lb of apples and 50 lb of potatoes for sale. The market price for apples (per pound) each day is a random variable with a mean of 0.5 dollars and a standard deviation of 0.2 dollars. Similarly for a pound of potatoes, the mean price is 0.3 dollars and the standard deviation is 0.1 dollars. It also costs him 2 dollars to bring all the apples and potatoes to the market. The market is busy with eager shoppers, so we can assume that he'll be able to sell all of each type of produce at the day's price.

- A.) Define your random variables, and use them to express the farmer's net income.
 B.) Find the mean
 C.) Find the standard deviation of the net income.