7.1 Expected Value.

Define: Discrete variable and continuous variable.
online

Fair game:

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Fair game: all parties involved have an equal chance of winning.

Expected Value, E(X): predicted average of all possible outcomes.

Method 1: Probability: $\boxed{P(x_i)}$ Random Variable: $\boxed{x_i}$

$$\boxed{E(X)=x_1P(x_1)+x_2P(x_2)+...+x_nP(x_n)}$$

$$E(x) = 1\left(\frac{1}{6}\right) + 2\left(\frac{1}{6}\right) + 3\left(\frac{1}{6}\right) + 4\left(\frac{1}{6}\right) + 5\left(\frac{1}{6}\right) + 6\left(\frac{1}{6}\right)$$

$$= \frac{1}{6} + \frac{2}{6} + \frac{3}{6} + \frac{4}{6} + \frac{5}{6} + \frac{6}{6}$$

$$= \frac{21}{6} = \frac{7}{2} = 3.5$$

Roll a dice 5 times. What is your expected value?

$$5(3.5) = 17.5$$

1. Consider a simple game in which you roll a single die. If you roll an even number, you gain that number of points, and, if you roll an odd number, you lose that number of points.

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a) What is the expected number of points per roll?

b) Is this game fair? Why?

$$E(x) = -1\left(\frac{1}{6}\right) + 2\left(\frac{1}{6}\right) - 3\left(\frac{1}{6}\right) + 4\left(\frac{1}{6}\right) - 5\left(\frac{1}{6}\right) + 6\left(\frac{1}{6}\right)$$

$$= \frac{-1}{6} + \frac{2}{6} - \frac{3}{6} + \frac{4}{6} - \frac{5}{6} + \frac{6}{6}$$

$$= \frac{3}{6} = \frac{1}{2}$$

Fair means $E(x) = 0$

Prize	Amount	Winners	
1	$10,000,000.00	0	0
2	$93,112.20	2	186224.4
3	$1,808.00	103	186224
4	$106.70	5,933	633051.1
5	$10.00	126,997	1269970
6	$10.00	116,153	1161530

3436999.5

$2

1,319,173

$$E(x) = \frac{\text{Revenue} - \text{Cost}}{\#\text{ of tickets}}$$

$$= \frac{2638346 - 3436999.5}{1319173} = \$-0.61/\text{ticket}$$