Probability Distributions & Expectation Values

Name: _____ Date: _____

Goal: Learn how to determine (calculate) the expected or average value of a particular experiment.

1. Consider rolling a single die. You are awarded points based on the following system. Complete the P(X) and P(X) Decimal columns.

Die # (X)	Points, x	P(x)	P(x) Decimal	xP(x)
1	**-2**			
2	**6**			
3	**1**			
4	**-7**			
5	**1**			
6	**2**			

2. Roll a single die 50 times and record the points (x) based on the system above. Record the **average** or **expected value**. (add up the points and divide by 50)

Expected value, *E(X)* = _____

3. Complete the ***xP(x)*** column of the table. This is done by multiplying the point value ***x***, by the probability of obtaining that point value ***P(x)***.

4. Add up the ***xP(x)*** column. That is find the sum of ***xP(x)***. Compare this to the value you found in step 2. Are they similar?

Sum of *xP(x)* =

It turns out that the **sum of *xP(X)*** is equal to the expected (average) value, ***E(X)*** of a probability distribution for a given experiment. This can be written mathematically as

$$E(X) = x_1P(x_1) + x_2P(x_2) + \ldots + x_nP(x_n)$$

Or more compactly;

$$\boxed{E(X) = \sum_{i=1}^{n} x_i P(x_i)}$$

The $\sum$ sign is the greek letter **S** and means ***Sum*** or ***Add***

How to determine if a game (based on random events) is fair or not?

In order for a game to be fair the expected value, ***E(X)*** must equal ***zero***.

<u>That is:</u> for a fair game ***E(X)=0***. Otherwise the game is unfair.

Questions:

Find the expectation value for each of the situations below and **determine if the game is fair**? Make tables similar to the one in this investigation. Show all of your work.

1. You flip a coin. If you flip heads you receive 7 points. If you flip tails you lose 4 points.

2. Using a single die you play a game. If the number you roll is odd you score 2 times the amount shown on the die. If the number is even you lose the amount shown on the die.

3. Create game rules for rolling a single die that result in a fair game. Show that the game is fair by determining the expectation value, *E(X)*. Share your rules with other class members.