Step-1

There is only one prime number which is also an even number, that is, 2. So, X will either choose 2 or any other prime number. Y will guess if it is even or odd with a gain or loss of $1.

Step-2

The payoff matrix for X is given below,

$$A = \begin{array}{c} \\ not2 \\ 2 \end{array} \begin{bmatrix} odd & even \\ -1 & 1 \\ 1 & -1 \end{bmatrix}$$

Step-3

Let X choose even prime number $\dfrac{2}{3}$ times and odd prime number $\dfrac{1}{3}$ times. Then the gain of X will be,

$$\frac{2}{3} \times 1 + \frac{1}{3} \times -1 = \frac{2}{3} - \frac{1}{3} = \frac{1}{3}.$$

Hence, X will have an advantage in this game if he uses this strategy to choose 2 more often.