# NCERT-2

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**Question 12.13.6.11** In a game, a man wins a rupee for a six and loses a rupee for any other number when a fair die is thrown. The man decided to throw a die thrice but to quit as and when he gets a six. Find the expected value of the amount he wins / loses.

**Solution:** In this game, a man wins 1 rupee if he gets a six when throwing a fair six-sided die, and loses 1 rupee for any other number. The man has decided to throw the die thrice but to quit as soon as he gets a six. We want to find the expected value of the amount he wins or loses.

Let's analyze the possibilities:

1) He gets a six on the first throw: In this case, he wins 1 rupee.
2) He doesn't get a six on the first throw but gets a six on the second throw: He neither wins nor loses any money. So overall amount is zero
3) He doesn't get a six on the first two throws but gets a six on the third throw: He loses 2 rupees from the first two throws but wins 1 rupee on the third throw, resulting in a net loss of 1 rupee.
4) He doesn't get a six in three throws: He loses 3 rupees.

Now, let's calculate the probabilities of these outcomes:

$$\text{Probability of getting a six on the first throw} = \frac{1}{6}$$

$$\text{Probability of not getting a six on the first throw and getting a six on the second throw} = \left(\frac{5}{6}\right)\times\left(\frac{1}{6}\right) = \frac{5}{36}$$

$$\text{Probability of not getting a six on the first two throws and getting a six on the third throw} = \left(\frac{5}{6}\right)\times\left(\frac{5}{6}\right)\times\left(\frac{1}{6}\right) = \frac{25}{216}$$

$$\text{Probability of not getting a six in three throws} = \left(\frac{5}{6}\right)^3 = \frac{125}{216}$$

Now, let's calculate the expected value:

$$\begin{aligned}\text{Expected value} &= \left(1\times\frac{1}{6}\right)+\left(0\times\frac{5}{36}\right)+\left(-1\times\frac{25}{216}\right)\\ &\quad+\left(-3\times\frac{125}{216}\right)\\ &= \frac{1}{6}-0+\left(-\frac{25}{216}\right)-\frac{375}{216}\\ &= \frac{36}{216}-0+\left(-\frac{25}{216}\right)-\frac{375}{216}\\ &= \frac{36-0-25-375}{216}\\ &= -\frac{364}{216}\\ &\approx -1.685\end{aligned}$$

So, the corrected expected value of the amount the man wins or loses is approximately -1.685 rupees. This means that on average, he can expect to lose about 1.685 rupees per game in the long run.