Research Square - Question

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### Please write a program that simulates and outputs the result of 100 rolls of a fair 20-sided die.What is your estimate for the average of those roles (including the standard deviation of that estimated average)? What is your estimate for the expected value of a single roll of a 20-sided die (including the standard deviation of that expected value)? Briefly explain why the two estimates are or are not the same.

Simulating 100 rolls is similar to generating 100 samples We will consider the range of values equal to the number of sides of the die

# set seed to get same results every time   
set.seed(123)  
numbers = 1:20  
random.numbers <- sample(x = numbers, size = 100, replace = TRUE)  
  
# average value  
mean\_value <- mean(random.numbers)  
mean\_value

## [1] 11.03

# standard deviation  
std <- sd(random.numbers)  
std

## [1] 5.250214

as can be seen mean or average of the experiment is :11.03

Standard deviation is : 5.2502

Expected variable of a random variable can be given by sum of probabilities multiplied by its respective event (where p(x)\*x is conceptually frequency of x divided by total frequency). The concept of expectation value or expected value may be understood from the following example. Let X represent the outcome of a roll of 20-sided die. The possible values for X are 1, 2, 3, 4, 5, …..20, each having the probability of occurrence of 1/20. The expectation value (or expected value) of X is then given by

(X)expected=1(1/20)+2(1/20)+…+20(1/20) = 10.5

We say that the average value is 11.03, with the distance of 0.53 from the expectation value of 10.5. If we roll the die N times, where N is very large, then the average will converge to the expected value, i.e.,(X)average=(X)expected. This is evidently because, when N is very large each possible value of X (i.e. 1 to 20) will occur with equal probability of 1/20, turning the average to the expectation value.