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STAT 417

**Project #1**

Part 1 Simulation:

Two balls are chosen at random. What is the probability that they are the same color?

Code:

## Probability of drawing two balls of the same color.

population = c(1,1, 0,0,0,0) # 1 = white ball, 0 = black ball

n = 100000

counter = 0

for ( i in 1:n){

x = sample(population, 2)

if (x[1]==x[2]){counter = counter + 1}

}

prob = counter/n

prob

Results:

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| N - value | 10 | 100 | 1000 | 10000 | 100000 | 1000000 | 10000000 |
| Probability | 0.4 | 0.46 | 0.449 | 0.4695 | 0.4653 | 0.4670 | 0.4664 |

Discussion:

In this part of the simulation, the code runs to select two balls and determine if they are the same color (They have the same value, 1 or 0). If the pick has an event in which the two balls are the same color then it increments a counter by 1. At the end of the simulation, the probability of the event, having the same color, is determined by dividing n(the population of picks) by the counter total(of favorable events). During the runs of the simulation, a small n value generally equated to a less accurate probability, with a much larger error. However, as n grew in magnitude, the simulation probability grew closer and closer to the theoretical value.

Part 2 Simulation:

Three balls are chosen at random. What is the probability that all three are black?

Code:

## Probability of drawing three black balls (0,0,0).

population = c(1,1, 0,0,0,0) # 1 = white ball, 0 = black ball

n = 100000

counter = 0

for ( i in 1:n){

x = sample(population, 3)

if (x[1]==x[2] && x[2] == x[3]){counter = counter + 1}

}

prob = counter/n

prob

Results:

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| N-value | 10 | 100 | 1000 | 10000 | 100000 | 1000000 | 10000000 |
| Probability | 0.1 | 0.17 | 0.202 | 0.1967 | 0.2005 | 0.20005 | 0.19987 |

Discussion:

In this part of the simulation, the code runs to select 3 balls at a time. The three balls are checked to determine if they are the same color in this case: black, black and black (or 0,0,0). In this simulation run, the event of three white balls cannot be obtained so there is no need to check to see if the three balls are white or black. If there are three values that are the same, they must be black because there are only two white balls. If a favorable event occurs, then a counter is incremented. At the end of the simulation, the probability of the event occurring is determined by diving n (the population of picks) by the counter (of favorable events). In the runs of the simulation, small values of n resulted in much greater difference between the theoretical probability and the experimental probability. Thus, to secure values close to the theoretical probability, very high values for n were used as well.