Problem of the Week
Problem B
What Are the Chances?

Problem

Many myths persist about how prior events affect the chances of future events.

a) Philip Tails flips a coin 19 times and gets tails every time. He thinks that on his 20^{th} flip he will have a better chance of getting heads because of what happened on the first 19 flips. Is Philip correct? Explain why or why not.

b) For a certain lottery, a player selects 6 different numbers from 1 to 49. The lottery randomly picks six different numbers from 1 to 49 (the order of the selection does not matter). You win if your numbers match the lottery selections. Last week, Lou Key won by choosing the numbers 1, 2, 3, 4, 5, 6. He decides he has a better chance of winning again next week if he picks different numbers. Is he correct? Explain why or why not.

c) A bag of marbles contains 10 red marbles, 8 blue marbles, and 6 yellow marbles. (Express your answers in (i) and (ii) reduced to lowest terms.)

(i) If you stick your hand in the bag and draw out one marble, what is the probability that it will be red?

(ii) If you draw a red marble, and then a blue marble, and remove them from the bag, what are the chances of drawing a red marble on your third draw?

(iii) How is the outcome in part (ii) different from that in parts a) and b)?

Solution

a) Phillip is not correct. Each flip of the coin is unaffected by any previous event. This is called an independent event because the outcome of the next event is NOT dependent on the outcome of any previous events.

b) No, picking different numbers will not give Lou a better chance of winning the lottery, as long as there is an equal chance of any of the numbers 1 to 49 being selected for each of the six numbers drawn.

c) For the bag of marbles containing 10 red marbles, 8 blue marbles, and 6 yellow marbles:

(i) the theoretical probability of drawing a red marble is

$$\frac{\text{the number of desired outcomes}}{\text{the total number of possible outcomes}} = \frac{10}{10+8+6} = \frac{10}{24} = \frac{5}{12}.$$

(ii) If a red marble and a blue marble are removed, there will now be 9 red, 7 blue, and 6 yellow marbles in the bag. Thus the theoretical probability of drawing a red marble is now

$$\frac{9}{9+7+6} = \frac{9}{22}.$$

(iii) In parts a) and b), none of the possible outcomes changed. Here, marbles are removed from the bag, and so the number of outcomes, and hence the probabilities, both change.