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|  | **Probability Quiz**  Also online at: <http://www.teacherlink.org/content/math/interactive/probability/interactivequiz/home.html> |
|  | **1.** In a lotto game, one has to choose 6 numbers from a total of 40. Julio has chosen 1, 2, 3, 4, 5, 6. Alison has chosen 39, 1, 17, 33, 8, 27. Who has a greater chance of winning?  A. Julio has a greater chance of winning.  B. Alison has a greater chance of winning.  C. Julio and Alison have the same chance to win.  The answer to this question is **C: Julio and Alison have the same chance to win.** Some people might be tempted to think that Alison has a greater chance of winning because her numbers appear to be "more randomly" chosen than Julio’s. However, since each of the forty numbers is selected independently, each number has a 1/40 chance of being selected for any of the six slots of the lotto number. Thus any sequence of numbers, regardless of whether it appears to have a pattern or not, has a 1/40 \* 1/40 \* 1/40 \* 1/40 \* 1/40 \* 1/40 = 1/(40)6 =  1/4096000000 chance of occuring.  **2.** When tossing a coin, there are two possible outcomes: either heads or tails. Luke flipped a coin three times and in all cases heads came up. Luke intends to flip the coin again. Is the chance of getting heads the fourth time...  A. Smaller than the chance of getting tails?  B. Equal to the chance of getting tails?  C. Greater than the chance of getting tails?  The answer to this question is **B: The chance of getting heads the fourth time is equal to the chance of getting tails.**  **3.** If you roll two dice simultaneously, which of the following has a greater chance of happening?  A. Getting the pair 5-6.  B. Getting the pair 6-6.  C. Both have the same chance.  The answer to this question is **A: Getting the pair 5-6.**  **4.** In a certain town there are two hospitals, a small one in which there are, on the average, about 15 births a day and a big one in which there are, on the average, about 45 births a day. The likelihood of giving birth to a girl is about 50%. (Nevertheless, there were days on which more than 50% of the babies born were girls, and there were days on which fewer than 50% of the babies born were girls.) In the small hospital a record has been kept during the year of the days in which the total number of girls born was greater than 9, which represents more than 60% of the total births in the small hospital. In the big hospital, they have kept a record during the year of the days in which there were more than 27 girls born, which represents more than 60% of the births. In which of the two hospitals were there more such days?  A. In the big hospital there were more days recorded where more than 60% girls were born.  B. In the small hospital there were more days recorded where more than 60% girls were born.  C. The number of days for which more than 60% girls were born was equal in the two hospitals.  The answer to this question is **B: In the small hospital there were more days recorded where more than 60% girls were born.**  **5.** The likelihood of getting heads at least twice when tossing three coins is...  A. Smaller than the likelihood of getting heads at least 200 times out of 300 times.  B. Equal to the likelihood of getting heads at least 200 times out of 300 times.  C. Greater than the likelihood of getting heads at least 200 times out of 300 times.  The answer to this question is **C: The likelihood of getting heads at least twice when tossing three coins is greater than the likelihood of getting heads at least 200 times out of 300 times.**  **6.** When choosing a committee composed of 3 members from among 12 candidates the number of possibilities is  A. Smaller than the number of possibilities when choosing a committee of 9 members from among 12 candidates.  B. Equal to the number of possibilities when choosing a committee of 9 members from among 12 candidates.  C. Greater than the number of possibilities when choosing a committee of 9 members from among 12 candidates.  Committees of 3 people come to mind more easily than committees of 9 people because they are simpler to form. However, there are just as many possible committees of 9 people. One way to think about it is that every time you choose a committee of 3 people, you have automatically selected a "partner" committee of 9 people. This "partner" committee is composed of everyone that you did not choose for the 3-person committee. As a result, for every unique 3-person committee that is possible, there is a unique 9-person "partner" committee.  The answer to this question is **B: Equal to the number of possibilities when choosing a committee of 9 members from among 12 candidates.**  **7.** Ethan and Gabriella each receive a box containing two white marbles and two black marbles.  Ethan extracts a marble from his box and finds out that it is a white one. Without replacing the first marble, he extracts a second marble. Which is more likely?  A. Ethan extracts a white marble.  B. Ethan extracts a black marble.  C. Both have the same chance.  In this case, two marbles are drawn and one of them is known to be white, but the color of the other is unknown. Since there were two black and two white marbles to start with and one of the whites has been accounted for, there is a 2/3 chance that the unknown marble is black. Ethan has already taken a white marble. Since there are only three marbles left and only one of them is white, it is more likely that Ethan will extract a black marble. Therefore, the correct answer is **B: Ethan extracts a black marble.**  **8.** Ethan and Gabriella each receive a box containing two white marbles and two black marbles.  Gabriella extracts a marble from her box and puts it aside without looking at it. She then extracts a second marble and sees that it is white. Which is more likely?  A. The first marble Gabriella extracted was white.  B. The first marble Gabriella extracted was black.  C. The first marble is equally likely to be white or black.  This problem is basically the same as Question 7. Just like in Question 7, two marbles are drawn and one of them is known to be white, but the color of the other is unknown. Since there were two black and two white marbles to start with and one of the whites has been accounted for, there is a 2/3 chance that the unknown marble is black. Gabriella has taken one marble and put it aside and then taken a white marble. According to Fischbein and Schnarch (1997): "If we know the second draw is white, then of the remaining three, from which the first one was drawn, two are black and one is white, so it is more likely that a black one was drawn" the first time (p. 102). Basically, Questions 7 and 8 express the same problem and thus have the same answer, **B: The first marble Gabriella extracted was black**.  A common misconception about cause-and-effect, which Fischbein and Schnarch call the *time-axis fallacy* or the *Falk phenomenon*, leads people to answer b for Question 7 and c for Question 8. These people correctly reasoned that if Ethan has already extracted one white marble, then he has a better chance of choosing a black marble the second time. For Part II, people think that the first marble that Gabriella drew has equal chances of being black or white because there were equal numbers of each color marble in the box when she took it. They think that the fact that she drew a white one later is irrelevant. They believe that what happens with the second marble cannot have any effect on the color of the first marble. This is technically true because an outcome cannot actually affect another outcome that has already happened. What people with this misconception do not realize is that "the *knowledge* of the second outcome should be used in determining the probability of the first outcome" (Fischbein and Schnarch, 1997, p. 102). This is why the probabilities of drawing a white marble on the first try and drawing a black marble on the first try are no longer equal.      **9.** Which is more likely?  A. Death by homicide.  B. Death by stroke.  C. Both have the same chance.  Many students will say that deaths by homicide are more prevalent than deaths by stroke because they see homicide being reported more frequently in the media. However, they neglect to take into consideration that reporters select stories for their newsworthiness not for their prevalence.  The correct answer to this question is: **B. Death by stroke**.  Adapted from Fischbein, E., & Schnarch, D. (1997). The evolution with age of probabilistic, intuitively based misconceptions. *Journal for Research of Mathematics Education, 28*(1), 96-105. |