

“Struck by Lightning” Supplementary Materials

Mathematical exercise about “hunting for fives”

You will be assigned to new groups. Introduce yourselves to each other before you begin. Then, working cooperatively with your group, answer the following questions.

1. Decide which group members will be “A”, “B”, and “C”.
2. Repeat the following 20 times: “A” rolls two fair six-sided dice. “B” writes down the number of fives which are showing. “C” writes down “1” if there is at least one five showing, otherwise “C” writes down “0”.
3. Next, have “B” and “C” each compute the *average* of the 20 numbers they have written down. What values should these averages be getting closer to? (Note: B’s values are related to the “expected number” of fives, while C’s values are related to the “probability of at least one” five.)
4. Repeat the previous three questions after switching who is “A”, “B”, and “C”.
5. What is the relationship between “expected number” and “probability of at least one” in this case? Which is larger? By how much? Why?
6. Repeat all of the previous questions with *four* dice instead of two dice. Then, if you have time, also repeat them with *one* die, and also with *three* dice, and with *five* dice, and with *six* dice.
7. How do the “expected number” and “probability of at least one” change when we increase the number of dice? (Explain as precisely as you can.)
8. It is sometimes said that “expected value is linear”. What does this mean?
9. Suppose we instead had n dice, for some number n . Try to come up with a *formula* for the “expected number” of fives, and also for the “probability of at least one” five. Which of these two quantities is easier to compute?
10. Recall that the probability that you will win the Lotto Max jackpot with a single choice of seven numbers is about one chance in 86 million. Should you be surprised if you win the jackpot this week?
11. Suppose that this week, a total of 100 million independent selections of seven numbers for the Lotto Max are made. What is the expected number of jackpot winners?
12. How is the expected number in the previous question related to the probability that there will be at least one winner this week? (Give as much detail as possible. Is it equal? close? more? less?)
13. Should you be surprised if at least one person wins the jackpot this week?