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THE EXPEDIENCY OF PLAYING THE LOTTERY IN TERMS OF THE THEORY OF PROBABILITY

Lotteries have always been in great demand among people. On average, in the US alone people spend more than 30 billion dollars a year on lotteries. The history of lotteries begins in the 17th century in Genoa, Italy. Every 6 months, the citizens of the city used to change two members of the local authorities. This position wasn't elected, but rather chosen by drawing lots. The names of 120 Council members were written on separate sheets of paper, and the citizens randomly drew out 2 sheets. The candidates whose names were written on the papers took new positions. Eventually, the citizens started making bets on candidates. Such an entertainment became very popular, and many didn't want to wait for the election to be able to bet. Consequently, in 1700 names were replaced by numbers, and players were asked to guess 5 numbers randomly. The more numbers gamblers guessed, the more money they would receive. Lotteries quickly spread throughout Europe, and then to North America [1, c. 104].

The primary goal of the article is to understand how a lottery works, who profits from it and whether it is possible to make money off a lottery in the long run. It isn't the same as just making money in a lottery. To make money in the long run means that we build a strategy of a game in such a way that we constantly win more money than we lose. To understand if it is possible to build such a strategy, we should consider some mathematical terms related to the theory of probability.

The classical definition of probability of a random event is as follows: the probability of a random event A is equal to the ratio of the number of possible cases

m favourable to the event A , to the number of all equally possible events n [2, c. 15]. For example, if only one ticket out of 10 wins, the probability that you will buy the winning ticket is 1:10. In turn, the expected value helps you understand the real price of the ticket. If the ticket costs more than its expected value, we will lose in the long run. If the price is less than the expected value, we will win. Let's see how we can find the expected value using the following example.

Imagine that you are offered to play such a game. You are given a ticket that can win 3 million dollars. There are 5 000 000 tickets, and there is only one winning ticket. Other 4 999 999 tickets will not pay you even a single cent. For this ticket you are asked to pay only \$1. If we buy a ticket, we will receive 3 million dollars with a probability of 1:5 000 000. With a probability of 4 999 999:5 000 000 we will get nothing. To calculate the expected value we have to multiply the winning amount of money by the probability of winning, and then add all these numbers. For our case $(1:5\,000\,000) \times 3\,000\,000\$ + (4\,999\,999:5\,000\,000) \times 0\$ = 3\,000\,000:5\,000\,000 = 0.6\$$. Therefore, the expected value of the ticket is 60 cents. This is the real price of our ticket. But we have to pay 1\$ for the participation in this game, which is 40 cents more than the real value of the ticket. That means that this game will not be profitable for us. On average, we will lose 40 cents on each ticket. So, to win a lottery you just have to find a lottery, where the expected value of a ticket is more than its price. But it's harder than it seems because such lotteries have existed very rarely, and nowadays they probably do not exist at all. If the price of a ticket in a lottery is less than its expected value, the owner of the lottery will be in the red. Thus, it will not be profitable for the owner of the lottery. By the way, not only lotteries, but also other gambling activities such as casino and slot machines are built on the same principle. That is why everybody can win only in a short run. But the longer you play, the more likely you will be in the red.

However, there were some interesting examples when the price of a lottery ticket was less than its expected value. The following story is about an American lottery "WinFall". Most lotteries have a so-called jackpot. This is the biggest prize that can be won. This prize increases for as long as nobody wins. The owners of the

lottery noticed that people were losing interest in their lottery because the jackpot hadn't been won for a long time. They changed the rules. When jackpot reached 2 000 000 \$, the jackpot was divided among those people who had won any prize. During regular runs, the expected value of a ticket was 79.8 cents, while the price of it was 2\$. Therefore, those tickets weren't quite profitable, as the price of a ticket was 2.5 times more than its expected value. But when the jackpot reached 2 000 000 \$, the expected value increased to 2.98\$, which is almost one and a half times more than the price of a ticket. While it seems that it cannot make sense for the owners of the lottery to offer this, we must not forget that during regular runs the expected value was too small, and people lost much more money than they won. Profitable days contributed to the popularization of the lottery, so the owners were still in the black. The first person to understand it, was a student of Massachusetts Institute of Technology, who worked on the project about comparative characteristics of lotteries in different states. He formed a group of friends, and they developed a strategy for winning a lot of money in a lottery. They were buying large quantities of tickets. At first, they bought a thousand tickets. Over time, they were buying tens of thousands of tickets. Later, the number of clubs buying tickets in this manner began to grow sharply, along with the number of tickets that were bought each time, while the methods allowing to win even more money became more advanced. Such clubs were called cartels and they were spending up to 300 000\$ on tickets on profitable days. As a result, they used to win enormous amounts of money [1, c. 110-114].

But nowadays we have computers, and it isn't a problem to find the expected value of a huge number of lotteries over a short period of time. The owners of lotteries understand it. That is why a chance to find profitable lotteries is close to zero. So, there is only one simple advice on how you can play a lottery without any risk of losing money. Everyone can use it, even without the knowledge of the probability theory. You should just not play the lottery, and you will never be in the red.

References

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