Andrew Johnson
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Analysis of PowerBall Project

Powerball: Lottery Model & Simulation

For this project, I chose to simulate the lottery because I wanted to see what the odds looked like. Before I started this project, I had a good idea that the odds weren't going to be pretty. You hear comparisons such as getting attacked by a shark, being struck by lightning, or winning the lottery. These sayings intertwine and I figured doing a project on the lottery would give me a good idea of what the odds look like and how they stack against you (although the odds of being struck by lightning would be a pretty cool project as well). Personally, I have never played the lottery. I don't consider myself a lucky person and I am a realist when it comes to things. I trust the math and common sense to not invest money into something that is highly unlikely (although I will buy a scratch ticket every now and then if I get a dollar back in change).

For this project, I structured my model based on the rules of Powerball. Basically, if you want to play, you pay $2 for a standard ticket and $3 for a Power Play ticket. The difference between Power Play is that your prize winnings will be multiplied by 2, 3, 4, 5, or 10. The multiplier is selected by a random factor with 10X being the least likely with a chance of 1 in 43 and 2X being the most likely with a chance in 1 in 1.79. The game works by drawing 5 white balls and 1 red ball. The white balls can be anything from 1 to 69 and must be unique, and the red ball can be anything from 1 to 26. When the drawing occurs, the white balls on your ticket do not have to be in the order drawn. There are nine different ways to win. If you match the red ball, you will at least win something. With the Power Play option, if you were to miraculously win the jackpot, your winnings will not be multiplied. If you match five numbers with the Power Play option, the max multiplier you will get is 2X.

As far as the code, I created a Ticket class to represent the ticket. All it was was an array of size 5 representing the five white balls, an integer representing the red ball, and the ticket cost. For the game itself, I took what I learned in Parallel & Cloud Computing and created a Monitor class to keep track of all the tickets being simulated at once. I used threads to run large amounts at once so I wouldn't have to wait an extremely long time for my simulations to run. I used the Monitor class to keep track of the total amount spent as well as performed some statistical calculations to show some human-friendly stats. My Thread class's job was to generate the random white balls and powerballs and add their findings to the Monitor class. This code was all written in Java.

For my simulations, I chose a few different scenarios that I found to be interesting that could represent the results in an appropriate manner. Since the lottery is drawn twice per week, I decided to do scenarios for playing twice per week for 1 year, 10 years, and a lifetime. After those, I did a simulation of purchasing approximately 100 million tickets on a single drawing. Then, I did a simulation comparing playing the standard $2 game, and the Power Play $3 game. Finally, I ran a simulation to go until a jackpot was reached.

For the scenario playing twice per week for a year, my findings were quite depressing. Since there are 52 weeks in a year, and we are playing twice per week, and a ticket cost $2, the total cost for this scenario was $208. I ran this simulation for 1000 people, and the lowest amount won was a whopping $8, and the highest was $164. The average across all 1000

people was a measly $37.89. The average payout was about 18% of the total cost to play and nobody made any profit (or came close to it).

The next scenario, playing twice a week for 10 years, yielded pretty much the same results as playing for 1 year. The total cost per person was $2080 and the lowest amount won was $257. This time though, 3 people actually made profit. Three people had hit the $50,000 ticket which was interesting to see. Lucky for them, but too bad so sad for the rest. The average payout for this group (minus the three $50,000 winners) was still about 18% of what they paid being $385.11.

Then, I did the scenario where 1000 people played the lottery every time it was offered for their life (60 years). This would cost them $12,480 each and I got some better results as far as winning goes. The lowest amount won in this situation was $1,908. I had two people win over a million dollars and 19 win more than $50,000. The number of people who made profit represented 2.1% of the population.

For my next scenario, I wanted to do a simulation of buying an enormous amount of tickets for one drawing to see what the results would look like. I remember the lottery a while back was at around $1.5 billion, and I would see celebrities purchasing huge amounts of tickets and I wanted to test this in my project. I don't think any of them bought 100 million tickets but I was able to simulate that in my project because why not, it's free anyway. The results of my simulation of approx. 102 million tickets showed that 96% of the tickets were losing tickets. This simulation had matched all five white numbers 7 times but missed the red ball for the jackpot. This at least resulted in $7 million payout which helps, but the overall results was just plain sad. They had spent $205 million on tickets and their payout was around $32 million. They may have been better off donating to a charity.

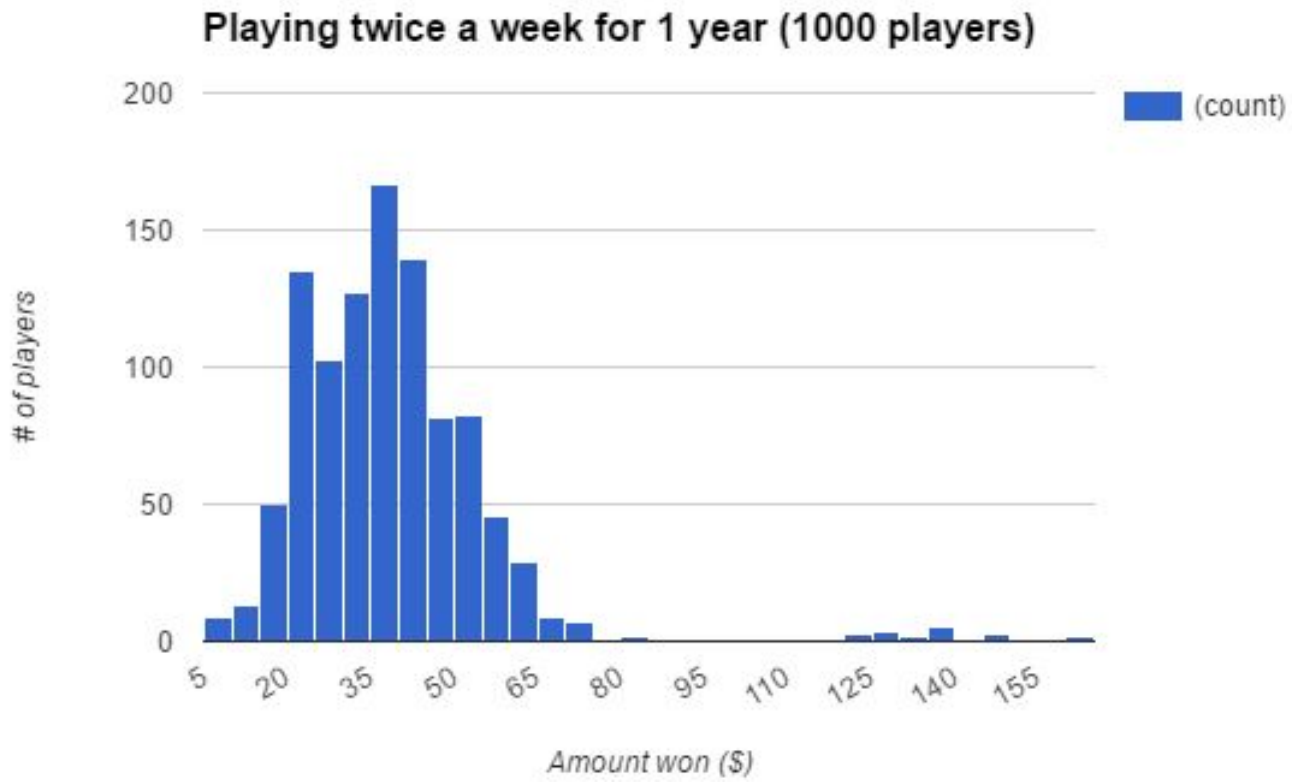
After that, I wanted to do a comparison of playing the standard way and playing with the Power Play option. This simulation was interesting. At a first glance I thought, the Power Play option could be the way to go. I had even watched some YouTube videos where people claim they always go for the Power Play. Afterall, it is only an extra dollar and you guaranteed at least a 2X multiplier on your payout. So I did a comparison of 10 million tickets with and without Power Play. Without Power Play, this costed $20 million and the payout was $3.45 million. With Power Play, this costed $30 million and the payout was $6.4 million. After briefly looking into the results, I noticed the Power Play option paid back more, so maybe it is the way to go after all. But with closer examination, without Power Play, they lost about $16.5 million, and with Power Play they lost about $23.5 million. This shows that the Power Play option is deceitful and should be avoided.

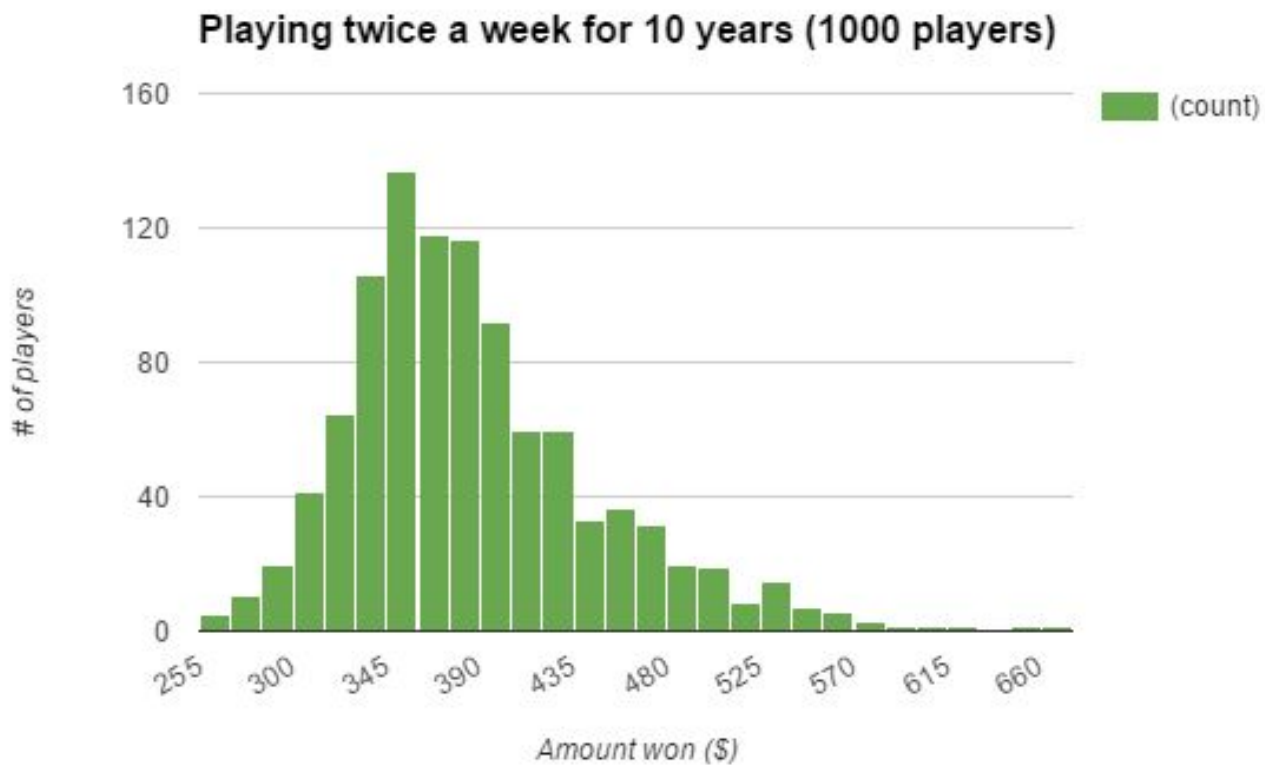
For my final simulation, I wanted to hit that dang jackpot. After all my simulations so far I had not seen it yet. This one was a little tricky because I would sometimes get an OutOfMemoryException so I had to change my model a little bit. Basically I set the simulation to continue running until a jackpot was reached. I had to start this before I went to sleep as who knows how long it would have taken. The next day it was almost like being a child on Christmas morning. I made my way to my computer and prayed that I would see a jackpot and not an exception. Thankfully, after 3 hours and 20 minutes a jackpot was hit. This jackpot was hit on around the 227th million ticket and it was really cool to see. I felt like I had really won the lottery (okay, maybe not really). This would have costed around $454 million, so if the jackpot was well

over that, and could cover the taxes, and would not have been split with anyone else, then this was a good investment.

Overall, I can conclude to stay far away from this game. I am not saying you should never play, because you cannot win if you do not play. But I don't suggest spending a huge percentage of your paycheck in attempt to win it big, the odds just aren't there. If you have a lot of money and don't really care what happens to it, maybe it would be better to send it to a charity you believe in and help someone who could use it. But I found this project to be very interesting and eye opening and I am now able to explain my findings to anybody to forewarn them on what is likely to be the result. By all means, buy a ticket every once in awhile and fantasize what you would do if you won. But please do not go investing large amounts of money in attempt to hit it big, it just isn't worth it.

Graphs and images can be found on the next couple pages.


Playing twice a week for 1 year (1000 players)
(count)
200
150
100
50
0
# of players
5
20
35
50
65
80
95
110
125
140
155
Amount won ($)


Playing twice a week for 10 years (1000 players)
(count)
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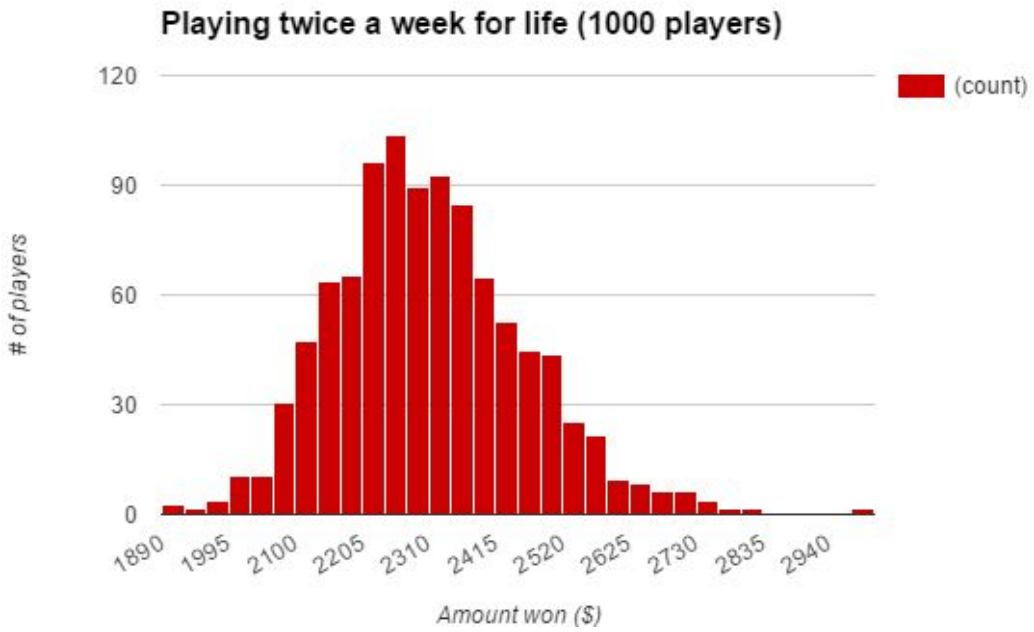
120
80
40
0
# of players
255
300
345
390
435
480
525
570
615
660
Amount won ($)



Numbers matched	Without powerball (tickets)	With powerball (tickets)	$ Earned w/o powerball	$ Earned w/ powerball	
0:	68,570,358	2,696,939	$0	$10,787,756	
1:	26,588,969	1,144,310	$0	$4,577,240	
2:	3,376,560	152,206	$0	$1,065,442	
3:	157,599	7,470	$1,103,193	$747,000	
4:	2,394	127	$239,400	$6,350,000	
5:	7	0	$7,000,000	$0	
Totals:	98,695,887	4,001,045	$8,342,593	$23,527,438	$31,870,031 (-$173,523,833)