# JetX analysis

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## 1 Introduction

Jetx is a casino game that has become famous due to its simplicity and how people have the control over the course of a run. A round typically goes like this:

1. Each player places up to 2 bets between 0.1€ and 300€ each.
2. The jet starts to fly from 1.00x and this multiplier keeps growing, at any moment the players can eject from the jet their bets winning the amount they have bet times the multiplier.
3. At some point, the jet will explode. The players who haven't ejected yet will lose their pending bets.

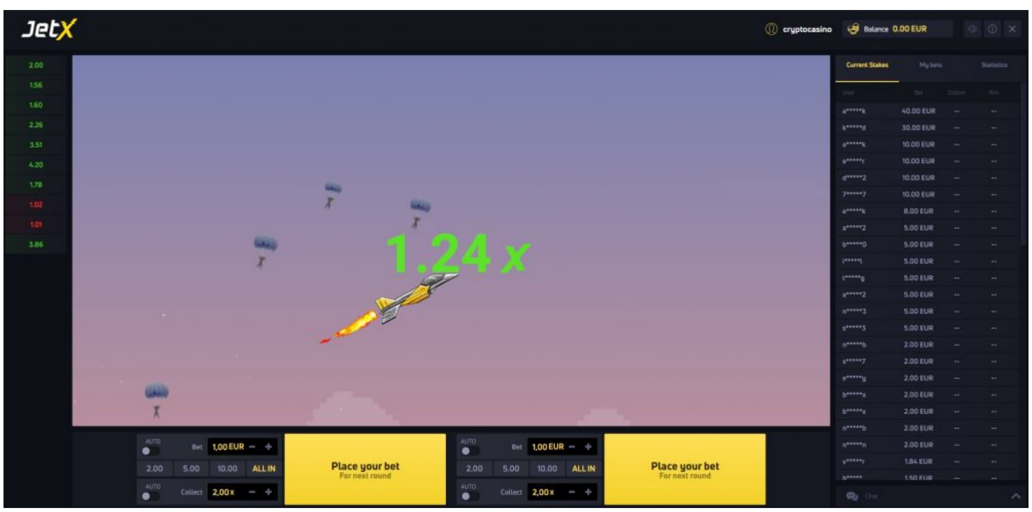


Figure 1: GUI of the website

The goal is to predict when the jet is going to explode. Pull out too early and your gains will be small, pull out too late and you will lose your bet. But the multiplier at which the jet explodes is unknown to the players until the round ends.

In order to analyze how Cbet.gg can make money, I gathered informations over 6000 rounds using a scraping script hidden to prevent bot detection. The data collected is the final multiplier, each individual bet that has been placed and each person's gain or loss at the end of the round. This allows us not only to see how much money has been gained or lost by the company but also study the probabilities behind Jetx.

# 2 Analyzing the data

## 2.1 Money earned

It is hard to believe that the company running this business can actually make money. It looks like we could just multiply our money over and over, and sometimes lose some, but regain it right after. Indeed this game is pretty popular, with an average total bet of 730€ per round (averaged over days and nights). If we consider that a round takes about 40 seconds, that is around 2000 rounds per day, so about 1.4M € that is bet daily. This casino game is a huge success.

Let's dive into the money earned by the company. Knowing the amount of money initially bet, and the cashouts of every player, we can calculate the money earned by the company fairly easily. Because it's pointless to look at the money earned each round, I have decided to cumulate the money earned by the company.

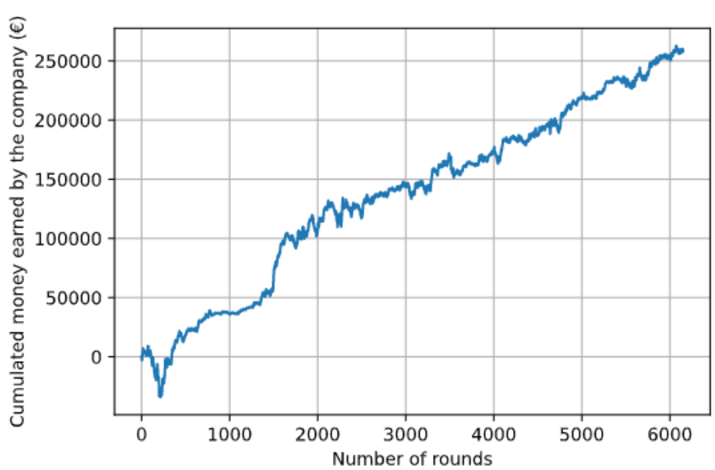


Figure 2: Cumulated money earned by the company over the rounds

Running a quick linear regression with no intercept on these data, we obtain a coefficient of 42.3, which means that on this period, Cbet has earned around

42.3€ per round. Considering around 730€ is bet per round, the average return on investment by a random player is $\frac{-42.3}{730} = -5.7 * 10^{-2}$. This means that everytime the average player bets 1€ he will get only 0.94€ back. We will see in the strategies section if we can get some better results.

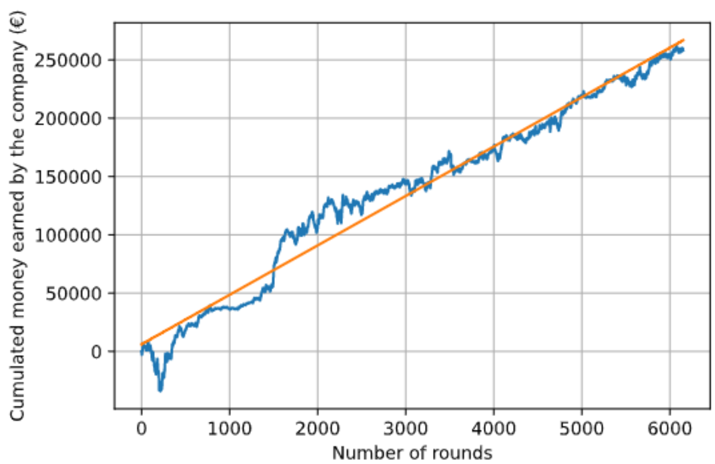


Figure 3: Cumulated money and regression

## 2.2 Multipliers

We dive deeper into the theory. To start with, let's see if there is a way to repeatedly make money on jetX on the long run. Let's assume an agent $A_x$ consistently plays the action bet and cash out at the multiplier $x$. What is the minimum amount of times this agent has to win to cover a loss. Another way of saying this is, what is the probability needed for the jet to crash higher than the multiplier $x$ chosen by the agent, so that our agent on the long run earns money. We can solve this easily by calculating the expected amount of money earnt by our agent. We call $X$ the random variable that gives us the final crash of the jet on the current run. We will assume that our agent bets 1€ as betting more implies multiplying all our equations by this amount.

$$\begin{aligned} E[\text{gain}] \geq 0 &\iff P(X \geq x)(x-1) - P(X \leq x) \geq 0 \\ &\iff P(X \leq x) \leq \frac{x-1}{x} \end{aligned}$$

The issue with this is that x is a number in $[1, \infty)$, which isn't convenient. Instead we can get back to a well known exponential law by the change of variable $x = e^x$. We then have the following condition in order to make money by always stopping at the value $e^x$.

$$E[\text{gain}] \geq 0 \iff P(X \leq e^x) \leq 1 - e^{-x}$$

Though this is problematic, as any jetx player knows that the probability of a multiplier of 1.00 is not equal to 0. Though, in the prior formula, take $x = 0$ and you obtain that in order to win money by always stopping at 1.00 (no gain), you must never lose. We can plot for all $x$ the potential multipliers the repartition function of a perfect model with a positive expected gain ($P_p(X \leq e^x) = 1 - e^{-x}$), and the real repartition function ($P(X \leq e^x)$ calculated from the data) .

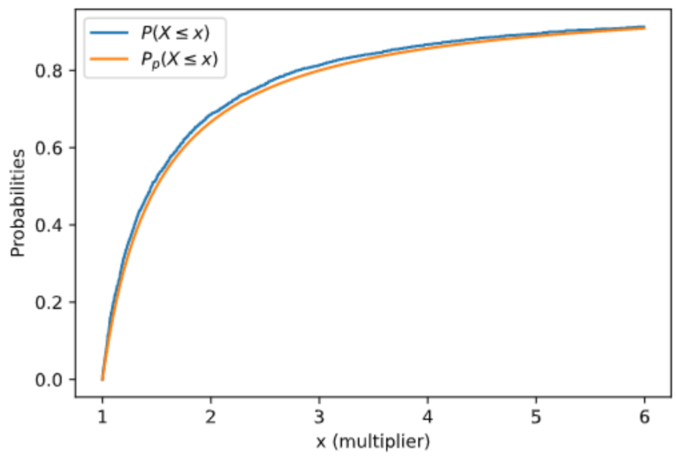


Figure 4: Perfect repartition vs real repartition of $X$

We can see on the graph that the blue curve is above the optimal curve, which means that we have exactly the opposite inequality:

$$P(X \leq e^x) \geq 1 - e^{-x}$$

which means that we have the following main formula of this report:

$$\forall x \in [0, \infty(,\ E[\text{Gains}_x] \leq 0$$

with $\text{Gains}_x$ the random variable that gives the gain associated to an agent playing on one round the strategy "Stop at multiplier $e^x$".

# 3 Analyzing the strategies

## 3.1 The auto-bet and auto-collect

This strategy, as we have seen before, has very little chance of working, especially on the long run. Let's say you autocollect at the multiplier x=1.5 for example, and bet every single round. We can estimate the expected gain for this multiplier and the variance through the real data: $E[\text{Gain}] = -0.046$ (better than the average player, recall that the average player made about -0.057 every round) and $V[\text{Gain}] = 0.52$. Note that the high variance is typically associated with gambling games, as it promises huge rewards. To make sure none of the multipliers work, we can still plot the expected gain for a bet of 1€ for each multiplier we want to stop at:

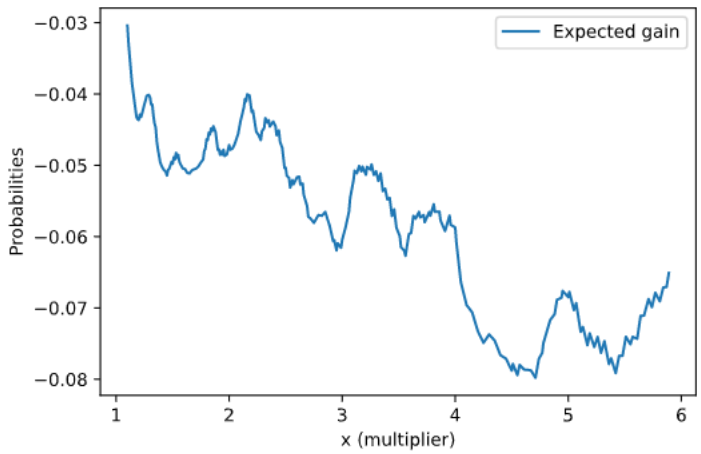


Figure 5: Expected gain for each goal multiplier

This figures explains pretty well the "low risk, low reward" mentality of these games, though this is not the best way to make money.

We can use the central limit to estimate our chance to have a positive gain after n iterations, n very large. We denote $G_n = \sum G_i$ with $G_i$ the gain after the round i using the strategy denoted before. We have that:

$$\frac{G_n - n\mu}{\sigma\sqrt{n}} \longrightarrow \mathcal{N}(0,1) \iff G_n \longrightarrow \mathcal{N}(n\mu, n\sigma^2)$$
$$\implies P(G_n \geq 0) = P(Z_n \geq 0),\ Z_n \sim \mathcal{N}(n\mu, n\sigma^2)$$

Over 10 rounds, we find a probability of not losing money of 0.48. Although, this method isn't quite accurate for 10 rounds, as n isn't large enough. Over 100 rounds, we can estimate the probability of not losing money about 0.26. And if you leave the website running during the whole night for about 1000 rounds, the probability drops to 0.03. As we can see, the more rounds you play, the harder it becomes to make money. Let's assume you want to use this strategy around 50 rounds, we can compute the probability of having a positive return on investment for each multiplier, and plot the graph of having a positive gain against the multiplier we chose to stop at. Here are the results:

The data doesn't look very smooth because it's an estimate made with the collected data passed through the central limit theorem. Though we can already see that the high risks multipliers are better choice if we want to make money

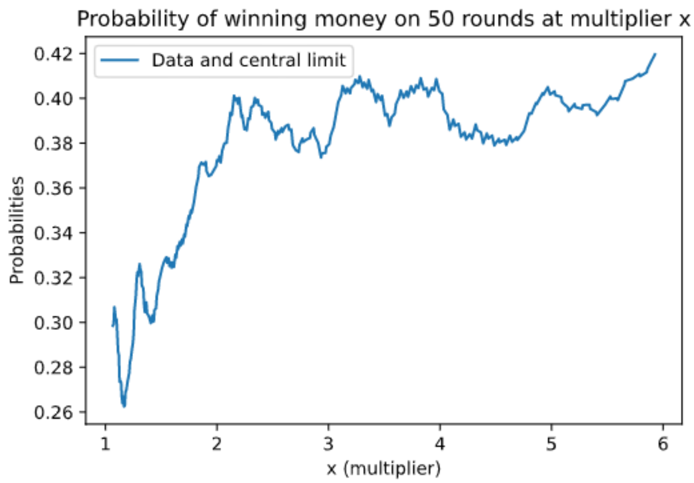


Figure 6: Probability of having a non-negative gain after 50 rounds for each multiplier we chose to constantly stop at.

on the long run. I wanted to see if this was my own fault or if the data really fit that representation. What we can do is take all the multipliers x, and for each of them take all the possible windows of 50 consecutive rounds, and look if we would have made money on that run or not. Then we can take the average to see the probability of making money during a 50 rounds session and compare it to the ones obtained with the central limit theorem.

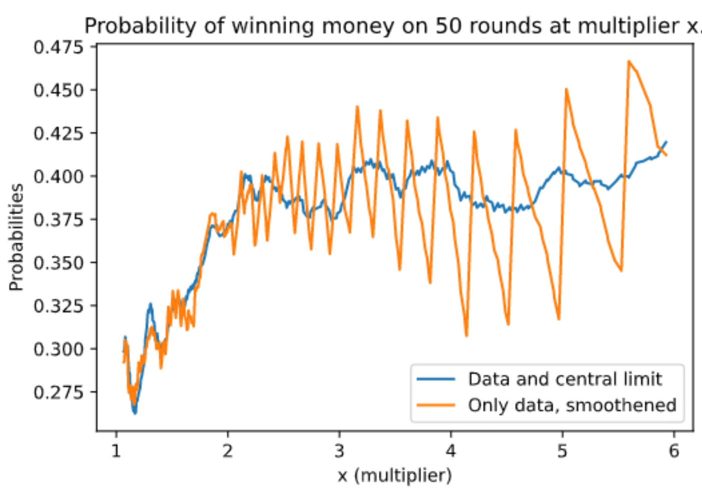


Figure 7: Comparison of probabilities of having a non-negative gain after 50 rounds for each multiplier we chose to constantly stop at.

The results are absolutely stunning. Not only we have verified our method, but we can see some local extrema that can't be explained by a continuous distribution of the probabilities. Using some local extrema detection, here are some of the few high chances of winning (over 50 rounds) multipliers: 1,41 1,98 3,39 3,63 5,61.

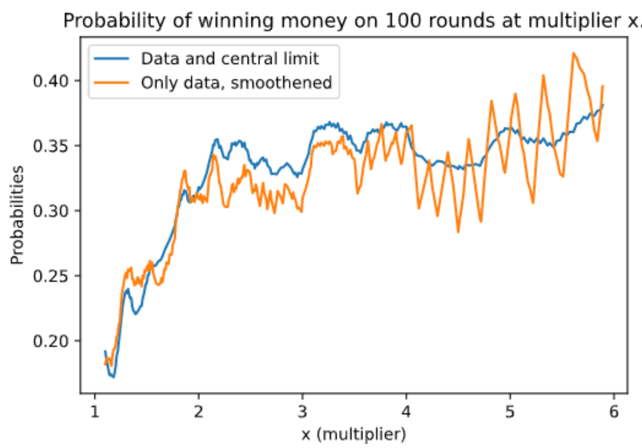


Figure 8: Comparison of probabilities of having a non-negative gain after 100 rounds for each multiplier we chose to constantly stop at.

We can try the same thing on 100 rounds to verify our data, and we roughly find the same extremas (see figure above).

## 3.2 The martingale

A martingale is a strategy designed to seemingly always earn money. It's a simple rule: choose a low amount of money to bet, for example 1€. Always try to reach the multiplier 2.00x. If you win, stay with the low bet, if you lose, double your bet. Repeat the same process over and over until you can't bet anymore or you've made enough money. Although this method could work, there are three problems. The first one is that your money isn't infinite. Even though you lost all, you could technically regain it all with just one more bet, the issue is that once your balance reaches 0, you can't regain it all. The second issue is that JetX doesn't allow you to bet more than 600€ per round, so even though you might have enough money, you wouldn't be able to do the same strategy. The last issue is that this strategy is seemingly so powerful that it's forbidden by the TOS. Indeed, you might not be able to withdraw your gains if some martingale has been detected in your behavior. You could try to hide it by delaying some of your bets and changing a bit the amount, so let's analyze why it wouldn't work.

Once again, we are going to calculate the expected money you can get, and the probability of gaining money on a certain amount of runs. Assume you have enough money to double up your bet T times in a row before your balance reaches 0 (we'll also assume that you start at 1€, and we'll write $p$ the value $P(\text{crash} \geq 2)$. Then T+1 cases are possible:

- Win instanly: you get 2€-1€ (win - bet) so 1€, the probability is $p$.
- Lose Win: you get 4€-1€-2€ so 1€, the probability is $p(1-p)$
- Lose Lose Win: 8€-4€-2€-1€ so 1€
  $\vdots$
- $\underbrace{\text{Lose Lose .. Lose}}_{\text{T-1 times}}$ Win so 1€, the probability is $p(1-p)^{T-1}$
- Lose T times in a row. Lose $2^T - 1$€, the probability is $(1-p)^T$

The expected gain is $1\underbrace{(1-(1-p)^T)}_{\text{P(Win)}} - (2^T - 1)\underbrace{(1-p)^T}_{\text{P(Lose)}} = 1 - 2^T(1-p)^T$. As we have seen theorically, $1 - p > 0.5$ because otherwise, one could always stop at 2.0x and make money on the long run. So this expectancy is always negative. Here is a short list of the expected gain for different values of T (if T=0 we don't bet so we can't lose money, the formula is still correct). We only go up to T=9, because afterwards we outpass the maximum bet value.

| T | E[Gain] | P(Loss) |
|---|---|---|
| 0 | 0.0 | 0.000 |
| 1 | -0.0536 | 0.527 |
| 2 | -0.1100 | 0.278 |
| 3 | -0.1696 | 0.146 |
| 4 | -0.2323 | 0.077 |
| 5 | -0.2984 | 0.041 |
| 6 | -0.3680 | 0.021 |
| 7 | -0.4413 | 0.011 |
| 8 | -0.5186 | 0.006 |
| 9 | -0.6000 | 0.003 |

Table 1: Expected gain and probability of losing all depending on the number of times the agent can double his bet

We can see the martingale as a way of making money more safely, though on the long run the player will lose more than he will win. Also we can see that the martingale with T=1 (betting only once and reaching 2.0x) is better than the average player (although not optimized). We already mentionned that the expected return for a random player was -0.057.

### 3.3 The double bet

I have seen this method being discussed as the ultimate secret method, however we will see why it doesn't work. The idea is the following: since cbet allows the player to place 2 bets, and cashout separatedly on each, we can place a huge bet that we will cashout very early, and a small bet that we will leave growing. Despite having a feeling of reimbursing our second bet with the first one, this method is equivalent to having two players performing the first strategy discussed, but with two distinct goal multiplier.

- The player one bets a lot of money on small multipliers, his expected gain is negative as we have seen before.
- The player two bets little money on high multipliers, his expected gain is also negative as we have seen before.

Hence, the expected gain of both, is nothing but the sum of two negative numbers, therefore also negative. This method will not work on the long term. And it's even worse as it creates two bets instead of one, therefore converging faster towards negative values according to the law of large numbers.

In conclusion this strategy isn't better than another one.

## 4 Can we predict the data

Work in progress..