Martingale Strategy

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1 Sure way to loose money

Description of the strategy: Bet on color, if you loose you double your bet, if you loose again, you double your bet again. You keep on doubling bets until you win, wining back all your money plus profit equal to the original stake.

X.....Ones wealth (how much you can bet)
x.....Initiall bet
n.....Number of round in which you run out of money

$$(2^n - 1) \times x = X \tag{1}$$

(n-1) is the number of times you double your bet.(1) Shows that you keep on doubling your bets, until you run out of money. The left hand side of the equation (sum of your bets) equals to the RHS (your total wealth).
EXAMPLE:
if n=10 (you run out of money in the 10th round) you will double your stake 9 times. Let's say initial bet x is x=2 and n=10, then the bets will go as follows: 2,4,8,16,...,1024.
Rearranging start gives us:

$$2^n = \frac{X}{x} + 1 \tag{2}$$

$$\ln 2^n = \ln \frac{X + x}{x} \tag{3}$$

$$n \times \ln 2 = \ln X + x - \ln x \tag{4}$$

$$n = \frac{\ln(\frac{X}{x} + 1)}{\ln 2} \tag{5}$$

Probability of loosing ones entire forune is: $(\frac{19}{37})^n$ (this is the probability that opposite color than the one on which you are beting is going to fall n-times). Probability of winning x is the complementary probability: $1 - (\frac{19}{37})^n$. The expected value of the bet is:

$$EV = (1 - \left(\frac{19}{37}\right)^n) \times x - \left(\frac{19}{37}\right)^n \times X = x \times \left(1 - \left(\frac{19}{37}\right)^{\frac{\ln(\frac{X}{x}+1)}{\ln 2}}\right) - X \times \left(\frac{19}{37}\right)^{\frac{\ln(\frac{X}{x}+1)}{\ln 2}} \tag{6}$$

Now I'll partially derive (6) with respect to X. This will show how is the Expected Value changing if I come to casino with more money (Gamblers say that if you come with more money, the color you are betting on will have to fall eventually).

$$\frac{\partial EV}{\partial X} = -(x+X) \times \left(\left(\frac{19}{37}\right)^{\frac{\ln(\frac{X}{x}+1)}{\ln 2}-1} \right) \frac{1}{(X+x)ln(2)} - \left(\left(\frac{19}{37}\right)^{\frac{\ln(\frac{X}{x}+1)}{\ln 2}} \right) \frac{1}{(X+x)ln(2)} \quad (7)$$

Which is unambiguously negative, the more money I bring, the higher my expected loss is. To show that the loss is always negative one needs to realize that $x \leq X$.If I plug $x = X$ in to (6) I get $-X/37$. Equation (7) tells me that the higher the X/x ratio is, the more I loose. Since I am loosing at the lowest possible ratino 1/1, I will be loosing for every other feasible ratio $Ratio \in [0, \infty)$. (Now I could partially derive wrt. x, but I don't feel like it right now. Maybe some other time...)