Roulette Problem

\[ P(\text{coming out ahead on any single play with strategy A}) = \frac{1}{38} = 2.6\% \]

\[ P(\text{ahead with strategy B}) = \frac{2}{38} = \frac{1}{19} = 5\% \]
M: Every time the wheel spins with strategy A, I expect to win/lose around ———
   Lose M = $-0.05

σ: Give or take around ———
   σ = $5.76

Math Fact: any popl. having only 2 possible values, the pop SD is
   \[ \sigma = \sqrt{p(1-p)}(\text{larger}) - (\text{smaller}) \text{\=[p(1-p)]} \]

Here, smaller value = -1
large value = +36

\[ P = \frac{1}{36}, \quad 1 - P = \frac{35}{36} \]

So \[ \sigma = \sqrt{\frac{1}{36} \cdot \frac{35}{36}} \]

[+$36$]

= $5.76

Your net gain after n=1000 $1 bet on a single # is like the SUM $\$ of n=1000
IID draws from single # population.

To come out ahead, $> 0$

To work out probability, need to sum (repetitions)
1. Long Run Mean = Expected Value of the sum $S = EV$ of $S = n \mu_{\text{math, fac}}$

in our example $n = 1, \ldots, 52$ (draws), $\mu_{\text{mean}} = 1000 \cdot .0626 = \$62.60$

At the end of $n=1, \ldots$ $\$1$ bets on single #
I expect to be ahead (behind) by $EV = -\$62.60$, give or take $\_\_\_\_\_\_$

2. Long Run SD of sum $S$ in imag dataset = Standard Error of the sum $S = SE$ of $S$

$SE_{\text{iid}}(S) = \sigma \cdot \sqrt{n}$

$\sigma \uparrow SE(S) \uparrow$

$n \uparrow SE(S) \uparrow$

in our example $SE = \$5.76 \cdot \sqrt{1000} = \$182$

$-53 \leq 30 < 53$

$S_{-1000 \$0 \$30,000}$

3. Long Run Histogram

$SE = \$182$

Central Limit Theorem (CLT)

$\frac{\$0 - (-53)}{\$182} + 0.29 \sim 39\%$ coming out ahead
Standard Limit Theorem (CLT) (as $n \to \infty$)

Long run histogram of sum / mean of $n$ number of IID draws from a population will look like normal curve.

The closer the pop histogram is to the normal curve is to begin with, the smaller that $n$ must be to get a good normal approximation.

If pop histogram is normal to begin with, then the long-run histogram of $S$ (or of mean) in imaginary data set is normal for all $n \geq 1$. 
SE $182

39%

$53 \quad $0

SE $182

34%

$53 \quad $0

\frac{\$0 - \$53}{\$127} = -0.42

Long Run Hist. of $S$ (single #)

Long Run Hist. of $S$ (Split)

risk seeking