

Calculating the Odds: The Casino Mogul App

The house always wins, but to keep players interested, it shouldn't appear to win by *that* much. Herein, we conduct a probabilistic analysis of the Casino Mogul app, and suggest prices and rewards consistent with this philosophy.

To begin, player and NPC horses were each given a speed from a normal distribution with standard deviation 0.1 centered at 0.872, in order to give a right tail > 1.0 that integrates to 0.1. Hence, for any given player/NPC horse $P(\text{faster than house}) = 0.1$. The overall probability of the house winning is therefore $P(\text{house wins}) = (1 - P(\text{faster than house}))^7 = 0.9^7$.

The probability $P(\text{winning}) = P(\neg(\text{house wins}) \cap \text{faster than NPCs})$. Each player/NPC horse has a $1/7$ chance of being the fastest. Hence $P(\text{faster than NPCs}) = n/7$, where n is the number of player horses. All told, then, $P(\text{winning}) = (n/7) \cdot (0.9^7)$.

The table below shows the probability of the player winning as a function of the number of the number of player horses. Also included are the risk (amount of money bid overall by the player), reward (amount of money the house puts up), and the expected value of house winnings per race. Risk and reward sum to \$26, the size of the pot.

H (# horses)	P(winning)	risk	reward	E(house winnings)
1	7.45%	\$2	\$24	\$0.06
2	14.91%	\$4	\$22	\$0.12
3	22.36%	\$6	\$20	\$0.19
4	29.81%	\$8	\$18	\$0.25
5	37.26%	\$10	\$16	\$0.31
6	44.72%	\$12	\$14	\$0.37
7	52.17%	\$14	\$12	\$0.44

$E(\text{house winnings})$ is found as $(P(\neg \text{winning}) \cdot \text{risk}) - P(\text{winning}) \cdot \text{reward}$. The graph below represents this expected value as a function of the number of horses the player has purchased. The size of the pot was deliberately chosen to give this relationship a positive linear correlation, so that while it may seem logical to the player to buy more horses in order to increase his/her chances of winning, doing so will actually increase the expected value of his/her losses.

Probable Gains for Casino

