



MQP: Analyzing “The Price is Right”

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Mathematics and Game Shows

When mathematic principles improve odds:

- Monty Hall problem from *Let's Make a Deal*
 1. There are three doors; two hiding a goat and one hiding a car
 2. The contestant chooses a door. Monty Hall (the host) then reveals a goat behind one of the doors and the contestant has the option to switch their selection
 3. Choosing to switch doors gives the contestant $\frac{2}{3}$ chance of winning, rather than the initial $\frac{1}{3}$ chance of winning



Mathematics and Game Shows

When pricing knowledge improves odds:

- Ted Slauson on *The Price is Right*
 - The Price is Right used thousands of items from a large catalog of prizes
 - Ted was a lifelong fan who noticed similar items each week and began to memorize them all
 - He attended the show 37 times. He eventually got to play but lost during the big wheel
 - The documentary Perfect Bid is about him helping many contestants on the show, one who got the exact price on the final showcase



About The Price is Right

- First aired in 1972 and is still on today every weekday
- Hundreds of games within the show have been developed, with about 80 in rotation at any given time
- Most games are won with a mix of pricing knowledge and chance
- Use of strategy in select games greatly improves the contestant's chances of winning

Price is Right Format

- Four players bid on one prize the closest without going over plays a game
- A pricing game is then played where players can win cash and prizes such as a car
- The Showcase Showdown where the 3 contestants who played games spin the big wheel for a spot on the final showcase
- The Final showcase is where two players bid on a set of prizes



Our Task

Create a catalog of all current games, including information such as:

- Description of the game and how it is played
- The odds of winning without strategy or pricing knowledge
- The strategy that can be applied to improve the odds of winning, if there is one
- How much the strategy increases the odds of winning

Cover up (Medium strategy)

Rules:
The wrong price of a car is shown, with potential correct numbers above the wrong digits in the price. The contestant must cover up the incorrect digits with correct digits in the price of the car. On each turn, if the contestant has at least one new digit correct, then the contestant is given another turn. The game ends when the contestant has formed the price of the car or has no new digits correct.



Strategy:

Assuming contestants know the first digit

Option A: Purposely choosing incorrect first digit

To continue playing of the next 4 digits one must be correct

Chance of losing on the spot $(2/3) * (3/4) * (4/5) * (5/6) = 1/3$

Therefore Chance of not losing is $2/3$

Option B - Choosing correct first digit

Which slot guessed correctly	% Chance losing next turn
1	1/5
1,2	2/5
1,2,3	3/5
1,2,3,4	4/5
Which are guessed correctly	% Chance losing next turn
1,2	$4/10 = .4$
1,3	$3/10 = .3$

Low-Strategy Games

- Games where the odds of winning are entirely up to chance
- Games where the only strategy is having general pricing knowledge

Example of Low-Strategy Games

- Most Expensive: contestant is shown 3 prizes, and must guess which one is the most expensive to win; 1/3 odds of winning, no strategy



Medium Strategy Games

- Games where strategy can moderately improve the odds of winning or the amount of winnings
- Games where strategies are only effective if the contestant is confident in his or her pricing knowledge
- Games where a choice the contestant can pick has better odds than other options

Examples of Medium-Strategy Games

Plinko:

- The contestant must identify the prices of small items to earn Plinko chips. They start with one and can win up to 5
- Then at the top of the board they release their chips one at a time into slots at the bottom each containing money amounts from \$0 to \$10,000

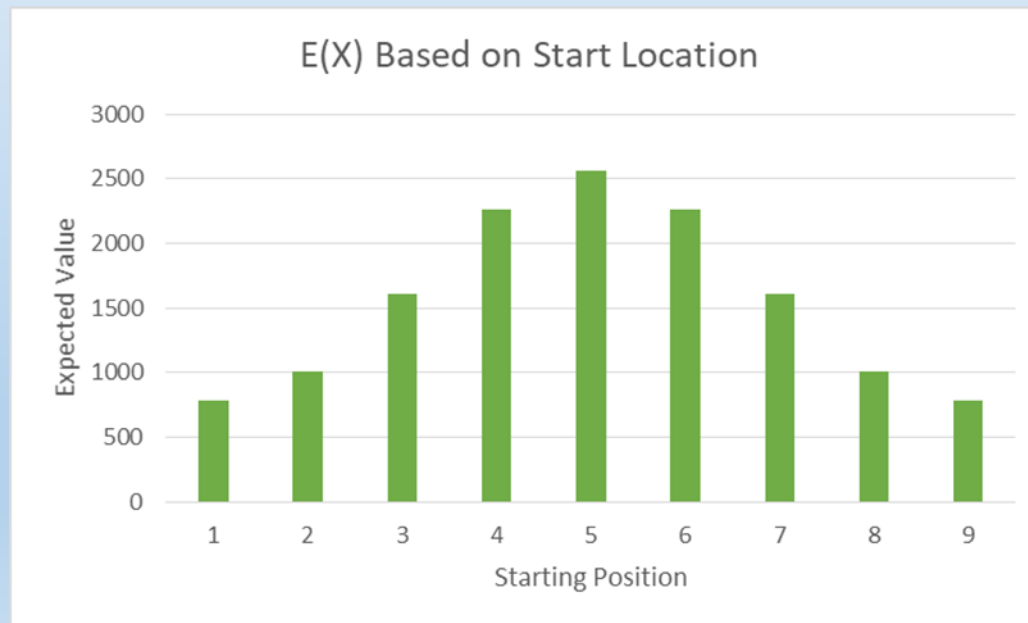


Strategy: Where should you drop it?



Plinko: Strategy

- Unsurprisingly dropping in the center closest to the 10,000 slot will give the largest expected value. (Over \$1,500 greater than slots 1 and 9)



Plinko: Winning any Amount

- However the standard deviation is also much higher for the middle slot as the odds of landing in the zero slots are also greater
- The standard deviation is the smallest on the outsides which are the slots with the least probability of landing in a zero

Starting Slot	Standard Deviation
Slot 1	2,258.74
Slot 2	2,711.94
Slot 3	3,348.85
Slot 4	3,863.19
Slot 5 (Middle)	4,060.79

Plinko: Winning any Amount

- If you simply wanted to win anything and did not care how much then dropping on either end would be the best strategy

Analytical Probability

Starting Slot	P(\$0)	P(\$10,000)
Slot 1	0.1133	0.0322
Slot 2	0.1534	0.0566
Slot 3	0.2500	0.1211
Slot 4	0.3466	0.1934
Slot 5 (Middle)	0.3868	0.2256

Simulation Results

Starting Slots	# 0's	# \$10,000
Slot 1	11,336	3,167
Slot 2	15,385	5,616
Slot 3	24,978	12,241
Slot 4	34,678	19,942
Slot 5 (Middle)	38,606	22,716

High-Strategy Games

- Games where the odds of winning are greatly improved even with no knowledge of the prices
- In some cases these games can be won every time

Examples of High-Strategy Games

Big Wheel

- The three constants who played games earlier in the show are brought on the stage
- They each get up to 2 spins on the big wheel to try and get as close to \$1.00 without going over
- The highest two scorers continue on to the final showcase



Big Wheel: Strategy

Factors to Consider

- Order the players are spinning in
- Values the preceding players have achieved
- Given the value of the contestant's first spin, whether the odds of winning are greater when staying with the first spin or spinning a second time

Big Wheel: Strategy

First Spin Value	First Contestant Final Value											
	0	0.05	0.1	0.15	0.2	0.25						
0.05	SPIN	0.340	SPIN	0.340	SPIN	0.340	SPIN	0.339	SPIN	0.339	SPIN	0.339
0.1	SPIN	0.339	SPIN	0.339	SPIN	0.339	SPIN	0.339	SPIN	0.339	SPIN	0.338
0.15	SPIN	0.338	SPIN	0.338	SPIN	0.338	SPIN	0.338	SPIN	0.338	SPIN	0.337
0.2	SPIN	0.337	SPIN	0.337	SPIN	0.337	SPIN	0.337	SPIN	0.337	SPIN	0.336
0.25	SPIN	0.334	SPIN	0.334	SPIN	0.334	SPIN	0.334	SPIN	0.334	SPIN	0.334
0.3	SPIN	0.330	SPIN	0.330	SPIN	0.330	SPIN	0.330	SPIN	0.330	SPIN	0.330
0.35	SPIN	0.324	SPIN	0.324	SPIN	0.324	SPIN	0.324	SPIN	0.324	SPIN	0.324
0.4	SPIN	0.316	SPIN	0.316	SPIN	0.316	SPIN	0.316	SPIN	0.316	SPIN	0.316
0.45	SPIN	0.307	SPIN	0.307	SPIN	0.307	SPIN	0.307	SPIN	0.307	SPIN	0.307
0.5	SPIN	0.295	SPIN	0.295	SPIN	0.295	SPIN	0.295	SPIN	0.295	SPIN	0.295
0.55	STAY	0.288	STAY	0.288	STAY	0.288	STAY	0.288	STAY	0.288	STAY	0.288
0.6	STAY	0.341	STAY	0.341	STAY	0.341	STAY	0.341	STAY	0.341	STAY	0.341
0.65	STAY	0.400	STAY	0.400	STAY	0.400	STAY	0.400	STAY	0.400	STAY	0.400
0.7	STAY	0.464	STAY	0.464	STAY	0.464	STAY	0.464	STAY	0.464	STAY	0.464
0.75	STAY	0.533	STAY	0.533	STAY	0.533	STAY	0.533	STAY	0.533	STAY	0.533
0.8	STAY	0.606	STAY	0.606	STAY	0.606	STAY	0.606	STAY	0.606	STAY	0.606
0.85	STAY	0.685	STAY	0.685	STAY	0.685	STAY	0.685	STAY	0.685	STAY	0.685
0.9	STAY	0.769	STAY	0.769	STAY	0.769	STAY	0.769	STAY	0.769	STAY	0.769
0.95	STAY	0.858	STAY	0.858	STAY	0.858	STAY	0.858	STAY	0.858	STAY	0.858
1	STAY	0.951	STAY	0.951	STAY	0.951	STAY	0.951	STAY	0.951	STAY	0.951

Examples of High-Strategy Games

Clock Game:

- Two prizes are shown to the contestant
- They guess the prices, one at a time
- Each guess the host will say whether the actual price is higher or lower
- They have 30 seconds to guess the exact price of both prizes

Clock Game: Strategy

- The strategy for this game is to bisect the price each guess
- Beginning at \$1000 the exact price can be guessed in under 11 guesses
- Without exact halves of numbers the price can still be guessed in under 13 guesses
- One second per guess gives this game a 100% win rate



Example

Price: \$113

Guesses: 8	1000	500	250	120	60	90	110	111-3
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**Thank you
Any Questions?**

