Blackjack "Perfect Strategy" Simulation

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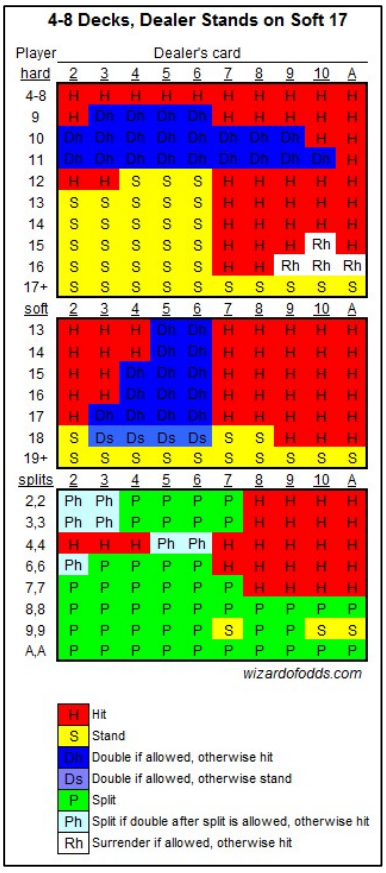
GitHub Repository

The goal of this project was to explore the outcomes of a "perfect" blackjack player.

During the Fall of 2020, I became very interested in the game of blackjack. A seemingly simple game, blackjack pits a dealer and player against each other in a duel for the highest sum of cards not to exceed 21. If you are unfamiliar with the game of blackjack, Bicycle Cards does a great job of simply explaining the game.

While blackjack is mostly random, due to the statistical nature of the game, there is a correct way to play. Certain decisions can harm your odds of winning, while others might improve your chances. I set out to explore the possibility of a "perfect" blackjack player. In this simulated world, a single player makes every decision in play according to what gives them the best chance to win. While I would like to explore the differences in strategies, I have adopted Wizard of Odds' 4-8 Deck Blackjack Strategy to simplify the simulation. **Figure 1** below shows this strategy.

Figure 1



Assumptions:

Each of these items influences the results of the player. Different combinations would be worth investigating in the future.

Number of Decks – The number of decks will change the outcomes of blackjack in the long run. With fewer decks, each card that has been dealt from the shoe has a larger effect on the odds of the next card to be dealt from the shoe. For example, in a shoe with any number of decks, the odds of being dealt a face card or 10 is 16/52 or 30.7%. If the first card that is dealt is a face card, there is one less face card in the shoe. For a shoe with one deck, the odds of the next card being a face card or 10 is 15/51 or 29.4%. While in a shoe with 4 decks, the odds of the next card being a face card or 10 is 63/207 or 30.4%. Thus, strategy may change due to the number of decks in the shoe.

Shuffle Threshold – This is the point in the shoe that a new shoe is brought in. As more cards leave a shoe, the odds of predicting the next dealt card increase. In casinos, the dealer lets the player insert the cut card at any point that they choose. When the cut card is reached in play, a new shoe will be used in the next hand.

Dealer Action – The dealer action determines the point at which a dealer must stand. Different casinos have different rules. For this simulation, we will assume that the dealer will hit until their total is 17. Additionally, dealers will stand on a "soft 17" when the dealer has an Ace that is being used as an 11.

Doubles, Splits, Surrenders – In this simulation, we will assume that a player may double and split but may not surrender. The player may double after a split.

Insurance – In this simulation, a player may not buy insurance.

Wager – In this simulation, a player will wager $1 on each hand.

Discussion of Findings:

Figure 2 below shows the results of 10 simulations of 10,000 hands played from an 8-deck shoe that is shuffled when less than 50 cards remain in the shoe. On average, the player won 43.4% of hands and lost $629.

Sim #	1	2	3	4	5	6	7	8	9	10		Average
PlayerWins	4203	4433	4412	4418	4324	4312	4344	4281	4304	4329		4336
DealerWins	5366	5101	5179	5014	5185	5206	5097	5419	5082	5178		5182.7
Pushes	875	870	805	896	889	889	904	846	917	862		875.3
# Splits	260	330	279	274	279	293	260	239	268	270		275.2
Double Downs	362	381	420	351	385	358	378	355	356	353		369.9
PlayerBusts	2049	1777	1862	1731	1856	1834	1772	2174	1714	1784		1855.3
DealerBusts	2206	2266	2272	2307	2195	2266	2230	2217	2258	2241		2245.8
Player Blackjack	405	450	464	461	396	407	437	458	425	444		434.7
Dealer Blackjack	456	473	464	455	442	455	430	452	452	459		453.8
# Shuffles	146	147	147	147	147	147	147	146	147	146		146.7
Profit/Loss	$(960.50)	$(443.00)	$(535.00)	$(365.50)	$(663.00)	$(690.50)	$(534.50)	$(909.00)	$(565.50)	$(627.00)		$(629.35)