Mathematical Analysis

Of The Following Game:

CASINO HOLD'EM

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Prepared By:

Michael Shackleford
The Wizard of Odds Consulting, Inc.
Las Vegas, NV

Rules

1. A standard 52-card deck is used.
2. Hand ranking is the same as conventional poker.
3. Play begins with each player making an ante wager, plus optional side bets, as explained later.
4. Two cards are dealt face down to each player and dealer. In addition, three community cards are dealt face up.
5. The player may examine his own two cards but sharing information should be discouraged.
6. Each player must decide to either fold or call. If the player folds he gives up his cards and his ante bet. If the player calls, the call bet must be equal to two times the ante bet.
7. The dealer will then deal two more community cards, for a total of five. The dealer will also turn over his own two cards.
8. Each hand (dealer's & player's) shall be scored according to the best five-card poker hand that can be composed out of the five community cards and the two personal cards.
9. The dealer must have a pair of fours or better to qualify. If the dealer does not qualify then the ante will pay according to the ante-winning pay table below and the call bet will push.
10. If the dealer qualifies and beats the player then the player will lose both the ante and call.
11. If the dealer qualifies and the player beats the dealer then the ante will pay according to the ante-winning pay table shown in table 1 below, and the call bet will pay 1 to 1.

Table 1 – Ante-Winning Pay Table

Hand	Pays
Royal flush	100 to 1
Straight flush	20 to 1
4 of a kind	10 to 1
Full house	3 to 1
Flush	2 to 1
All other	1 to 1

12. If the dealer qualifies and ties the player then both ante and call bet will push.
13. In addition, there are two optional side bets. The first is titled AA+ and is based on the poker value of the player's two cards and first three community cards. There are four pay tables available as shown in Table 2.

Table 2 – AA+ Pay Tables

5-Card Hand	AA+ Pay Table A	AA+ Pay Table B	AA+ Pay Table C	AA+ Pay Table D
Flush	25 to 1	100 to 1	100 to 1	100 to 1
Straight flush	25 to 1	50 to 1	50 to 1	50 to 1
4 of a kind	25 to 1	40 to 1	40 to 1	25 to 1
Full house	25 to 1	30 to 1	25 to 1	25 to 1
Flush	25 to 1	20 to 1	25 to 1	25 to 1
Straight	7 to 1	7 to 1	7 to 1	7 to 1
Three of a kind	7 to 1	7 to 1	7 to 1	7 to 1
Two pair	7 to 1	7 to 1	7 to 1	7 to 1
Pair of aces	7 to 1	7 to 1	7 to 1	7 to 1

14. The second of the two optional side bets is called the Progressive 5/7 and is based on the player's two cards and five community cards.
15. The meter for the Progressive 5/7 shall be seeded and re-seeded at $1000.
16. 65% or 70% of all money bet shall be directed towards the jackpot meter, according to the choice of casino management.
17. All wins should be subtracted from the jackpot meter.
18. The cost of the progressive side bet is always $1.
19. The progressive side bet shall pay according to table 3. Progressive bet wins are on a "for one" basis, in other words the player does not keep his original wager, even if he wins.

Table 3 – Progressive Pay Table

Hand	Pays
Royal flush	100% of Meter
Straight flush	10% of Meter
4 of a kind	$100
Full house	$10
All other	Loss

Casino Hold ‘em Analysis

Table 4 is the return table for Casino Hold ’em. The table shows the probability and contribution to the return for all possible outcomes, assuming optimal player strategy.

Table 4 – Return Table for Casino Hold ‘em

Event	Pays	Combinations	Probability	Return
Player wins with royal flush	102	736,259,040	0.000026	0.002700
Player has royal flush, dealer doesn't qualify	100	119,892,960	0.000004	0.000431
Player wins with straight flush	22	6,001,122,284	0.000216	0.004747
Player has straight flush, dealer doesn't qualify	20	1,089,672,828	0.000039	0.000784
Player wins with four of a kind	12	41,419,896,552	0.001489	0.017870
Player has four of a kind, dealer doesn't qualify	10	909,499,320	0.000033	0.000327
Player wins with full house	5	589,505,037,660	0.021195	0.105973
Player wins with flush	4	505,131,419,580	0.018161	0.072645
Player wins with straight or less	3	6,426,670,016,572	0.231060	0.693181
Player has full house, dealer doesn't qualify	3	24,601,676,832	0.000885	0.002654
Player has flush, dealer doesn't qualify	2	168,883,536,432	0.006072	0.012144
Player has straight or less, dealer doesn't qualify	1	5,521,376,219,148	0.198512	0.198512
Tie	0	678,596,916,580	0.024398	0
Player folds	-1	5,009,067,102,600	0.180093	-0.180093
Player loses	-3	8,839,701,755,612	0.317817	-0.953451
Total		27,813,810,024,000	1	-0.021576

The lower right cell reflects a house edge of 2.16%. This is the ratio of the expected player loss to the initial wager. On average the player will raise 81.99% of the time, for an average final bet of 2.64 times his ante bet. The ratio of the expected player loss to the average wager, known as the “element of risk” is 2.16%/2.64, or 0.82%.

I have never quantified a player strategy for Casino Hold ’em. My program determines proper strategy by brute force, cycling through every possible combination of the river, turn (fourth and fifth community cards) and the dealer’s up card. All I can offer is the statistic above, that on average the optimal strategy player will raise 81.99% of the time.

AA+ Analysis

Table 5 is the return table for pay table A of the AA+ side bet. The lower right cell shows a house edge of 6.40%.

Table 5 – Return Table for AA+ Pay Table A

Player 5-Card Hand	Pays	Combinations	Probability	Return
Royal Flush	25	4	0.000002	0.000038
Straight flush	25	36	0.000014	0.000346
4 of a kind	25	624	0.000240	0.006002
Full house	25	3744	0.001441	0.036014
Flush	25	5108	0.001965	0.049135
Straight	7	10200	0.003925	0.027473
Three of a kind	7	54912	0.021128	0.147899
Two pair	7	123552	0.047539	0.332773
Pair of aces	7	84480	0.032505	0.227537
Other	-1	2316300	0.891241	-0.891241
Total		2598960	1.000000	-0.064023

Table 6 is the return table for pay table B of the AA+ side bet. The lower right cell shows a house edge of 6.26%.

Table 6 – Return Table for AA+ Pay Table B

Player 5-Card Hand	Pays	Combinations	Probability	Return
Royal Flush	100	4	0.000002	0.000154
Straight flush	50	36	0.000014	0.000693
4 of a kind	40	624	0.000240	0.009604
Full house	30	3744	0.001441	0.043217
Flush	20	5108	0.001965	0.039308
Straight	7	10200	0.003925	0.027473
Three of a kind	7	54912	0.021128	0.147899
Two pair	7	123552	0.047539	0.332773
Pair of aces	7	84480	0.032505	0.227537
Other	-1	2316300	0.891241	-0.891241
Total		2598960	1.000000	-0.062583

Table 7 is the return table for pay table C of the AA+ side bet. The lower right cell shows a house edge of 6.00%.

Table 7 – Return Table for AA+ Pay Table C

Player 5-Card Hand	Pays	Combinations	Probability	Return
Royal Flush	100	4	0.000002	0.000154
Straight flush	50	36	0.000014	0.000693
4 of a kind	40	624	0.000240	0.009604
Full house	25	3744	0.001441	0.036014
Flush	25	5108	0.001965	0.049135
Straight	7	10200	0.003925	0.027473
Three of a kind	7	54912	0.021128	0.147899
Two pair	7	123552	0.047539	0.332773
Pair of aces	7	84480	0.032505	0.227537
Other	-1	2316300	0.891241	-0.891241
Total		2598960	1.000000	-0.059959

Table 8 is the return table for pay table D of the AA+ side bet. The lower right cell shows a house edge of 6.36%.

Table 8 – Return Table for AA+ Pay Table D

Player 5-Card Hand	Pays	Combinations	Probability	Return
Royal Flush	100	4	0.000002	0.000154
Straight flush	50	36	0.000014	0.000693
4 of a kind	25	624	0.000240	0.006002
Full house	25	3744	0.001441	0.036014
Flush	25	5108	0.001965	0.049135
Straight	7	10200	0.003925	0.027473
Three of a kind	7	54912	0.021128	0.147899
Two pair	7	123552	0.047539	0.332773
Pair of aces	7	84480	0.032505	0.227537
Other	-1	2316300	0.891241	-0.891241
Total		2598960	1.000000	-0.063561

Progressive 5/7 Analysis

Table 7 is the return table for the 5/7 Progressive side bet with a 65% contribution rate. The wins for the top two awards shown are averages, based on a 65% contribution rate and $1000 re-seed value. The lower right cell reflects a return of 68.23%, or house edge of 31.77%.

Table 7 – 5/7 Progressive Side Bet – 65% Contribution Rate

Player 7-Card Hand	Pays	Combinations	Probability	Return
Royal flush	$4,231.97	4,324	0.000032	0.136780
Straight flush	$423.20	37,260	0.000279	0.117863
4 of a kind	$100.00	224,848	0.001681	0.168067
Full house	$10.00	3,473,184	0.025961	0.259610
Other	$0.00	130,044,944	0.972047	0.000000
Total		133,784,560	1.000000	0.682321

Table 8 is the return table for the 5/7 Progressive side bet with a 70% contribution rate. The wins for the top two awards shown are averages, based on a 70% contribution rate and $1000 re-seed value. The lower right cell reflects a return of 73.23%, or house edge of 26.77%.

Table 8 – 5/7 Progressive Side Bet – 70% Contribution Rate

Player 7-Card Hand	Pays	Combinations	Probability	Return
Royal flush	$5,062.93	4,324	0.000032	0.163637
Straight flush	$506.29	37,260	0.000279	0.141006
4 of a kind	$100.00	224,848	0.001681	0.168067
Full house	$10.00	3,473,184	0.025961	0.259610
Other	$0.00	130,044,944	0.972047	0.000000
Total		133,784,560	1.000000	0.732321

The cost of the $1000 re-seed is 3.23% of the return.

Conclusion

This analysis was performed in C++ by cycling through all 27.8 trillion possible combinations of player, dealer, and community cards. This took my program a month to cycle through every combination.

If you any interested party have any questions my contact information is below.

E-mail: mail@gamingmath.com
Phone: 702-804-0015
Postal mail: 9200 Sienna Vista Dr., Las Vegas, NV 89117

Regards,



Michael Shackleford, A.S.A.