7. Fine Tuning your Game

Even if you are playing your count system perfectly, there are additional ways you can further improve your game.

The discussions in the chapter involve detailed blackjack simulations and comparisons. To complete this kind of detailed analysis, we used Blackjack Audit exclusively, our advanced blackjack simulation software. You do not need *Blackjack Audit* to follow this chapter, but you may find the program very helpful as you complete your own analysis and fine tuning of your game. You can download a free evaluation copy at our web site: www.deepnettech.com/bjaudit.html. All of the data in this chapter can be replicated using *Blackjack Audit* and the High-Low supplementary database for *Blackjack Counter*.

A minimum of 300 million rounds of blackjack were used for all the expectation computations throughout this book (and up to 1 billion in many cases). For risk of ruin calculations, a minimum of 5000 blackjack sessions were executed, each allowing up to 10 million rounds.

7.1. Expected Time to Win

It is important to understand the amount of time it should take you to reach a certain level of profit. The Risk of Ruin simulation (ROR) in *Blackjack Audit* provides us with the necessary data to compute the expected number of rounds.

To determine time from rounds, we need to know how many hands we will play per hour. This depends on the number of players at the table, the number of decks in the shoe, and the speed of the dealer. Typically, you will end up playing between 75 and 300 hands per hour. This mainly depends on the number of players, with head-to-head (i.e. one player) being the fastest. The number of players generally decreases as the minimum bet increases. We'll use the following assumptions to make our calculation of rounds per hour:

- **Minimum bet:** $5 for eight deck, $25 for single deck.
- **Number of players:** 4 players for eight deck games, 2 players for single deck.
- **Rounds/shoe:** From the *Blackjack Audit* reports, we can see that we average 117 hands per shoe (including the dealer) in eight deck games, and 14 in single deck. This is partially affected by the different penetrations as well (75% for eight deck, 66% for single deck).
- **Player rounds/shoe:** The rounds per shoe divided by the number of players plus one (for the dealer). We will use $117/5 \cong 24$ for eight deck, and $14/3 \cong 5$ for single deck.
- **Shoes/hour:** We'll use 4 shoes/hour for eight deck, and 20 shoes/hour for single deck. Note this these numbers take into account the fewer number of players for the single deck game.
- **Rounds/hour:** We use this equation to derive the rounds per hour: (player rounds per shoe) $\times$ (shoes per hour). This yields $24 \times 4 \cong 100$ for eight deck games, and $5 \times 20 \cong 100$ for single deck.

So, we can see that 100 hands/hour is quite reasonable for all of our casino conditions. You may get more hands per hour if you are playing head-to-head blackjack, or if you are

playing with a very fast dealer. You may get much slower rates of play if there are more players at the table, or if some players play very slowly.

Once we have a rounds per hour value, we could simply use the expectation and average bet per round to estimate the hourly earnings rate (expectation × average bet × rounds/hour). This method is generally acceptable, but *Blackjack Audit* allows us to run risk of ruin simulations to evaluate our earning rates empirically. The table below confirms that the two methods yield statistically identical results[20]:

Index set	Dbl.	Bet range	Min. bet	Exp.	Avg. bet	Bankroll (5% ROR)	Rounds to dbl	Actual win rate	Expected win rate
Multi1: D8, noDAS, H17	Any	1-10	$5	.22%	$11.25	$17000	705,740	$2.48	$2.48
Multi2: D8, DAS, H17	Any	1-10	$5	.35%	$11.36	$10825	273,259	$4.10	$3.98
Multi3: D8, DAS, S17	Any	1-10	$5	.52%	$11.35	$7450	123,349	$6.04	$5.90
Multi4: D8, noDAS, S17	Any	1-10	$5	.39%	$11.24	$9790	237,774	$4.42	$4.38
Single1: D1, noDAS, S17	Any	1-3	$25	1.15%	$55.80	$1680	13,122	$64.48	$64.17
Single2: D1, DAS, S17	Any	1-3	$25	1.27%	$56.25	$1500	10,545	$71.12	$71.44
Single3: D1, noDAS, H17	10-11	1-3	$25	.69%	$54.00	$2720	35,640	$37.88	$37.26
Single4: D1, noDAS, H17	Any	1-3	$25	1.01%	$55.85	$1920	16,748	$56.72	$56.41
Single5: D1, DAS, H17	Any	1-3	$25	1.13%	$56.25	$1775	13,434	$63.27	$63.56

Table 8: Hourly win rates for different games

The expectation and average bet data were produced using standard simulation runs in *Blackjack Audit*. The 'Rounds to double' column was determined by running sessions in *Blackjack Audit* until the specified bankroll was reached. 5000 sessions were run for each row (around 500 million blackjack rounds/row), yielding the average rounds to double the bankroll. Notice that the actual win rate and calculated win rate are very close, as expected. Notice also that the average bet in the 'Single3' game is slightly lower since less doubling bets occur.

Some interesting mathematical facts are behind this data:

1. **Minimum bet is linearly related to bankroll,** for a fixed set of casino conditions. For example, using a $15 to $150 bet spread in a 'multi3' game increases the 5% ROR bankroll requirement to 7450 × 3 = $22,350.

2. **The rounds to double stays constant as the minimum bet changes,** for a fixed set of casino conditions and equivalent ROR bankroll. For example, it will still take 110,000 rounds to double a $22,350 bankroll using a $15 to $150 bet spread in a 'multi3' game.

[20] For this table, we used a *Blackjack Audit* ROR simulation with these settings: upper limit: bankroll value, lower limit: none, round limit: none, sessions: 5000. Bet size as indicated.

3. **The hourly win rate is linearly related to the minimum bet,** for a fixed set of casino conditions. Hence, one way to make money more quickly is too increase your minimum bet and bankroll accordingly.

People familiar with other blackjack resources such as Stanford Wong's *Professional Blackjack* may notice that the win rates above do not correspond. Wong's benchmark game has a win rate of $16/hour. Notice though that his benchmark game differs from our standard 'Multi3' game. Wong uses six decks, 85% penetration, noDAS, S17, a 1 to 10 bet spread, and a minimum bet of $10. Using *Blackjack Audit* and a comparable simulation results in an expectation of 0.58% and an average bet per round of $23.77, yielding an hourly win rate of $13.79 (assuming 100 hands per hour as Wong does). The remaining difference is caused by our simulation using a 75% penetration, since a one deck plug (85%) is not available.

7.2. Winning Faster

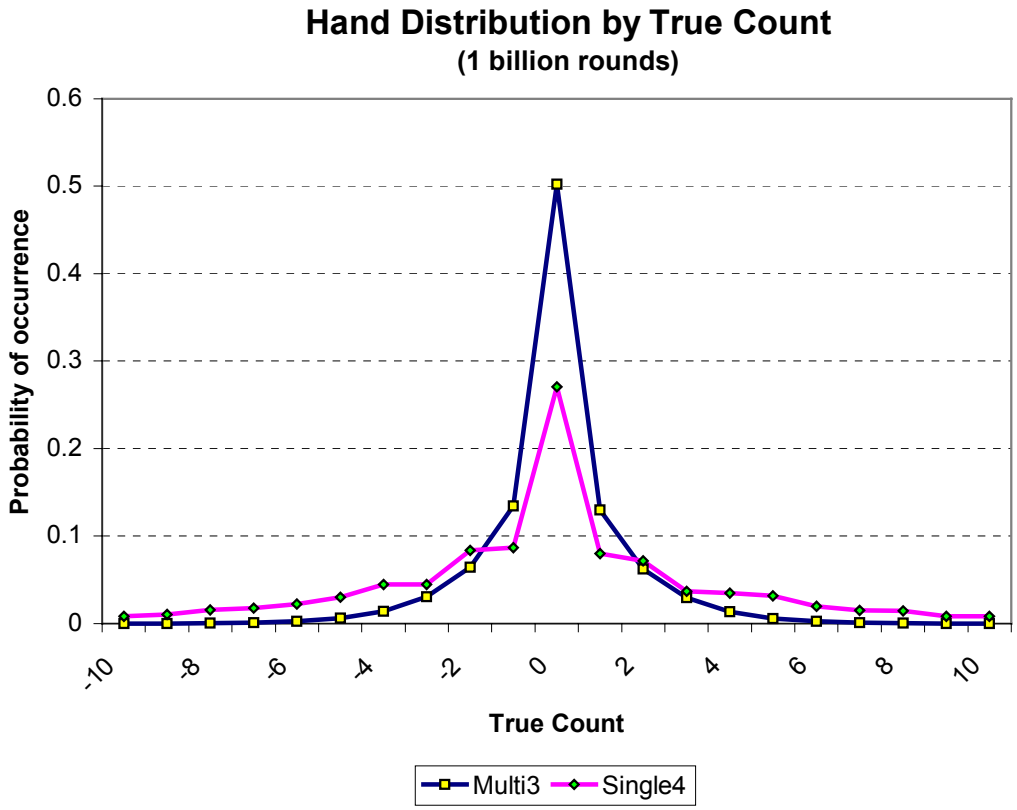
As you proceed through this chapter, you will learn that expectation is not the only attribute of a count system that affects your earnings.

Single deck versus eight deck

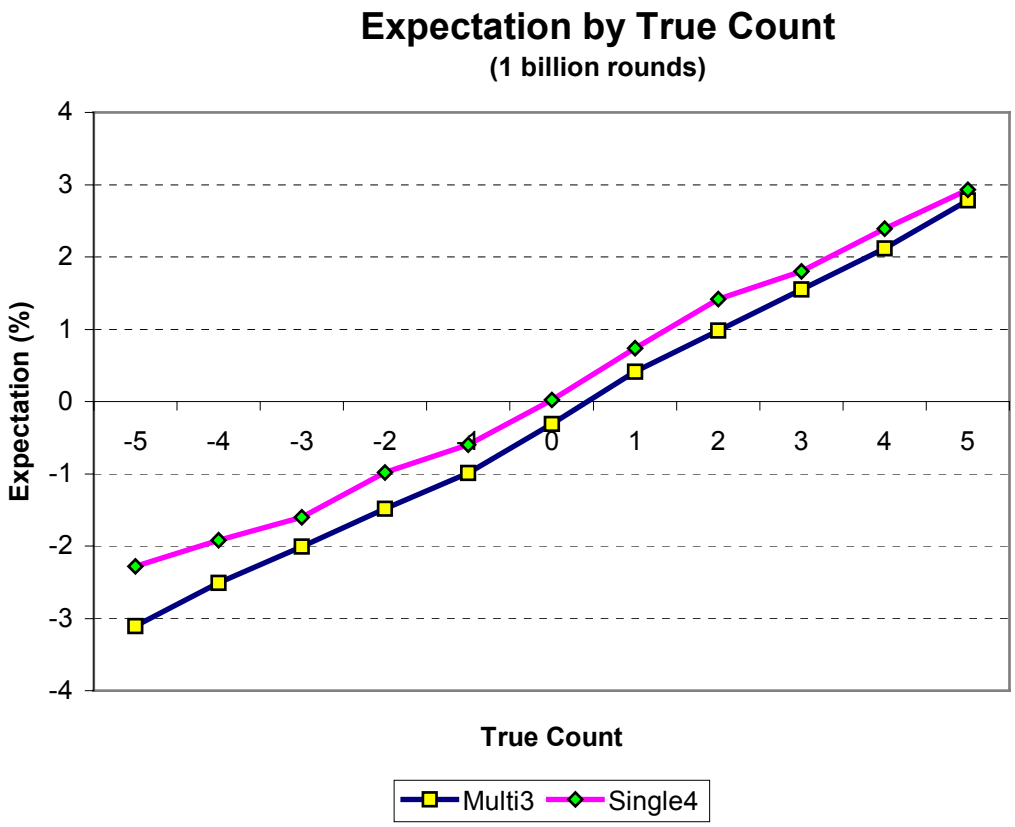
A very surprising result in the above table is the magnitude of difference between the earning rates in single and multi deck games. Even if you use a more comparable $15 to $150 bet spread in the best eight deck game (our standard multi3 variant, DAS/S17), the hourly win rate is still less than half of the worst single deck game (single3). This is why most blackjack experts recommend single and double deck games for players looking to maximize their winnings. This result is true for several reasons:

- **More positive expectation hands:** In single deck blackjack, players have a positive expectation at a true count just above zero, even with poor rules such as 'single3'. As such, High-Low instructs you to increase to two betting units at a count >= zero in single deck games. In eight deck games, you do not have an advantage until the true count reaches 1, where you increase the bet to 3 units. Only 24% of hands occur with positive expectation in our standard eight deck game (multi3), whereas 59% of hands in a typical single deck game (single4) occur with a player advantage. 27% of these positive expectation hands occur in the true count range of 0 to 1. This explains why indices have more affect on expectation in single deck games, since index plays at higher true counts occur more frequently. Note the area distributions under the curves in the following chart comparing our benchmark eight game to a typical single deck game (single4 as listed throughout this book)[21]:

[21] *Blackjack Audit* produces the data for this chart in its standard simulation run. The earnings for each player hand of Blackjack are classified by the initial true count when the bet was placed. This data is found in the 'System count statistics' table in the simulation report.



- **Better expectation:** The overall expectation in single deck games is two times or more greater than that of multi-deck. This is especially true if you are playing with the full index sets in single deck. As the chart below shows, the expectation is much better for all true count values (the range is limited to true counts that had sufficient occurrences in eight deck to be statistically valid).



Raising your bets

Your hourly earning rate is directly related to your minimum bet; if you double your betting range from $5/$50 to $10/$100, you will double your hourly earning rate. The drawback is that you must double your bankroll as well to maintain the same risk of ruin. This subtle point is easy to disregard in practice, and can have large consequences on your earning potential.

Suppose, for example, that you normally play blackjack with a $5 to $50 bet spread and a $5000 session bankroll using our standard 'multi3' game (eight deck, DAS, S17, full High-Low). On arrival at the casino, the tables are busy and you can only play at a $15 table, but it does have the added benefit of using six decks. Although you intend to play a 1 to 10 bet spread, you actually limit your highest bet to $75 as you nervously watch your bank fluctuate radically in front you. The following chart compares these two playing environments[22]:

[22] The expectations were computed using a standard *Blackjack Audit* simulation with 300 million rounds. For the eight deck game, we used a standard ROR simulation with 5000 sessions. For the six deck games we used 15,000 sessions. For all three ROR simulations we set the rounds limit to 'none' (run until bank won or lost), and the upper and lower bank limits to $5000.

Statistic	8 deck game: 1-10 bet spread $5 min bet	6 deck game 1-5 bet spread $15 min bet	6 deck game: 1-10 bet spread $15 min bet
Expectation	0.52%	0.37%	0.71%
Average bet/round	$11.35	$26.50	$37.19
ROR ($5000 bankroll)	11%	28%	30%
Avg. rounds to double bankroll	64,387	21,560	7455
Avg. rounds to lose bank	67992	21,603	7676
Expected hourly win rate	$5.90	$9.80	$26.40

Table 9: Affects of adjusting the bet spread

Compare the middle six deck game to the eight deck game:

- **Bad:** About 1 in 3 times you play, you will lose all $5000 and walk out a grand loser.
- **Good:** When you do win, you will win almost twice as much even though the expectation is worse (caused by the smaller bet spread).
- **Bad:** You will lose (or double) your $5000 bankroll about three times faster.
- **Summary:** The loss caused by the decreased bet spread is not met by the gain from two less decks

Now, consider the game in the third column, which uses the same bankroll, but has you stick to the proper $15 to $150 bet range. The expectation increases almost **50%** over the eight deck game, simply by removing two decks (the increased bet does not affect the expectation). Not surprisingly, the win rate jumps up to $37 per hour. Yet, the risk of ruin is almost unchanged from the middle game. This amazing result can be understood by recognizing that the significantly improved expectation tempers the fluctuations caused by the larger bets, the exact opposite of what we saw in the middle game! The only down side is that your big win or loss is going to happen 3 times faster still over the middle game.

This revealing exercise reinforces an observation made earlier in this book: most of the earnings potential in multi-deck blackjack is delivered by using a large bet spread (not indices). Hopefully this analysis shows you the huge risks of intentional or unintentionally lowering your bet spread.

Changing your bankroll

Another subtle way to protect your earnings is to increase your bankroll. In practice, this means allowing yourself to tolerate larger losses and continue playing. In this analysis, you will see how lowering your bankroll and changing your playing style can drastically affect your performance.

Suppose the analysis in the prior section has hit home, and you decide to play the six deck game with a 1 to 10 bet spread, and $15 minimum bet. You decide the most you can afford to lose is $1000, so you play for a fixed amount of time, leaving if at any point

you lose $1000. The following table shows the results for different amounts of playing time[23]:

Game: 6 deck, DAS, S17, 75% penetration, $15 min bet, 1-10 bet spread			
Statistic ($1000 bankroll)	**4 hours**	**8 hours**	**12 hours**
% sessions bankroll lost	30%	45%	53%
% of profitable sessions	50%	46%	42%
% of unprofitable sessions	50%	54%	58%
Avg. rounds/session	341	587	790
Avg. rounds/hour	85	73	66
Avg. winnings/session	$81.34	$143.54	$196.28
Avg. winnings/hour	$23.85	$24.45	$24.85

Table 10: Affect of using a very small session bankroll

At first glance, the table seems to show that the more you play, the more often you lose! Yet, the average winnings are positive and the earning rate per hour is constant, as is expected statistically (the expectation does not vary in these conditions). This surprising result is caused by the fact that you are using a very small bankroll and very large bets, but you are continuing to play without an upper limit (only a time limit). Although you leave the game when you are down at most a modest amount of money (in proportion to the minimum bet and bet spread), you do not do the same when you are up an equal amount. The result is that your fewer winning sessions will be more profitable than expected statistically, but you will have more losing outings overall. Notice also that the average rounds/hour goes down with the longer sessions; this is caused by the fact that you are more likely to exhaust your small $1000 bankroll well before your time limit expires.

Suppose you repeat the same playing conditions with an initial $5000 bankroll (which is still far less than the 5% ROR bankroll of $18,300). Hence, you will leave the casino only if you lose $5,000[24]:

[23] The following *Blackjack Audit* ROR simulation settings were used: no upper limit, $1000 lower limit, 500,000 sessions, and 400, 800 and 1200 respectively for the number of rounds.

[24] The following *Blackjack Audit* ROR simulation settings were used: no upper limit, $5000 lower limit, 500,000 sessions, and 400, 800 and 1200 respectively for the number of rounds.

Game: 6 deck, DAS, S17, 75% penetration, $15 min bet, 1-10 bet spread			
Statistic ($5,000 bankroll)	**4 hours**	**8 hours**	**12 hours**
% sessions bankroll lost	0%	0%	1%
% of profitable sessions	54%	55%	57%
% of unprofitable sessions	46%	45%	43%
Avg. rounds/session	400	800	1198
Avg. winnings/session	$106.31	$208.97	$314.50
Avg. winnings/hour	$26.58	$26.12	$26.25

Table 11: Affect of using an appropriate session bankroll

Once again, the results are very surprising. With a $5000 bankroll, you might expect to lose about 15% of the sessions (less than the 30% risk of ruin, as noted in the earlier table). But the period of play is so short in relation to the bankroll that you almost **never** lose $5000 (less than 6000 lost sessions out of 1,500,000 in total).

This analysis shows why it is acceptable to have a different session bankroll from your total bankroll. Your session bankroll defines the amount of money you are going to play with on each casino outing, and should correlate to the length of time you want to play and your accepted level of risk. Your total bankroll is the maximum amount of cumulative loss across all sessions that you are willing to tolerate.

These revealing exercises reinforce the following observation made earlier in this book: play with an appropriate bankroll to maintain a low ROR. If you don't, expected statistical fluctuations are going to play havoc with your nerves!

"I've planned a trip to a new casino, I'm all practiced up, and I'm ready to play! I've got the full –3 to +3 High-Low count indices down pat, and I'm playing with very few errors and high confidence. I even called the casino ahead of time and the rules are good: six deck, DAS, H17, with plenty of $5 minimum tables they say. What they didn't say, and I didn't realize until I made the long trip to the casino, is that they use continuous shuffling machines on all tables with less than $15 minimum bets!

Well, I had a bankroll of $1000, but that was based on a $5 to $50 bet spread. I played anyway at the $15 tables, figuring I could handle the game easily.

Before long, expected earnings fluctuations were killing me. Once I was down $500, playing a 1 to 10 bet spread with $150 bets at the high true counts was too much to stomach… the most I could shove out was $75. Soon, I was left with only $100 in front of me, and I was faced with the prospect of not being able to cover my doubles or splits. In less than 3 hours, I lost the whole $1000 bankroll, and learned a lesson to remember:"

Play with a sufficient bankroll that covers the table stakes and allows you to play the bet spread as called for.

Different casino rules

Suppose you have a choice between two different casino games:

1. **Game #1:** 8 deck, DAS, S17, 75% penetration.
2. **Game #2:** 6 deck, DAS, H17, 75% penetration.

Which is the better game to play? We have already analyzed in detail the negative consequences of playing with an insufficient bankroll, so let's assume you will play with an appropriate bet spread and bankroll in both cases. The question is whether the decreased number of decks provides enough benefit to overcome the loss due to H17[25].

Expectation:	**Game #1:** D8, DAS, S17	**Game #2:** D6, DAS, H17
Full High-Low indices, 1-10 bet range	0.52%	0.56%
Fab18 indices, 1-10 bet range	0.50%	0.52%
No play indices, 1-10 bet range	**0.41%**	0.39%
Full High-Low, spread to 3 hands on big TC	0.70%	**0.80%**

Table 12: DAS/S17 8 deck, versus DAS/H17 six deck

[25] We used a standard *Blackjack Audit* simulation to generate this data. 100 million rounds for each simulation, system setup as indicated. For the last row, a hand spread setting of ' 3,2,4,3' was used.

In the last row, we changed the *Blackjack Audit* simulation to spread to two hands at a true count of 3, and to three hands at a true count of 4 or greater. Although this increases the risk of ruin since more money is being wagered, it allows us to capitalize on the advantage at positive true counts delivered by the fewer number of decks.

If you are playing with indices (even just the Fab18 indices), the games have almost identical expectations. The only case where you should avoid the six deck game is if you are playing with basic strategy and only using the count to adjust your bets. In all other cases, the six deck game is a bit better. If you play additional hands on high counts, then the six deck game has a significant 15% improvement over the eight deck game.

With the numerous subtle differences in blackjack games at different casinos, it is very important to use a proper simulation tool such as *Blackjack Audit* to compare the expectations. Although many blackjack books have tables that provide adjustments for different rules, they rarely take into account card counting techniques, indices, or hand spreading.

7.3. Longevity

Sometimes, your goal in playing is not to maximize your profit, but how long you can enjoy playing without losing money. This is often important if you have a much smaller session bankroll, want to be to maximize the amount of time you can play, and are happy with a low expectation near or slightly above zero.

Lowering your bet spread

Your longevity at the table is mostly determined by the minimum bet, your bankroll, and the standard deviation of the game (the amount of variance or fluctuations in your winnings). The wider your bet spread, the greater the variance and bankroll fluctuations. Hence, lowering your bet spread is one simple way to improve your playing time. The following table shows the expectation and expected playing time for different multi-deck gaming conditions (using the full High-Low count system with indices)[26]:

[26] For all of this data, both basic *Blackjack Audit* and ROR simulations were used. To compute the rounds, the following settings were used: upper/lower limit set to $500/$1000 respectively, no rounds limit, 2000 sessions.

Index set	Min. bet	1-2 bet range			1-3 bet range		
		Exp.	Rounds: $500	Rounds: $1000	Exp.	Rounds: $500	Rounds: $1000
Multi1: D8, noDAS, H17	$5	-.37%	4442	16790	-.24%	3404	13219
Multi2: D8, DAS, H17	$5	-.24%	4367	16947	-.10%	3337	12933
Multi3: D8, DAS, S17	$5	-.05%	4387	17303	**.08%**	3313	13107
Multi4: D8, noDAS, S17	$5	-.18%	4544	17754	-.05%	3410	13596
Multi1: D6, noDAS, H17	$15	-.27%	504	1969	-.11%	379	1428
Multi2: D6, DAS, H17	$15	-.14%	489	1901	**.02%**	368	1391
Multi3: D6, DAS, S17	$15	**.04%**	493	1912	**.20%**	369	1387
Multi4: D6, noDAS, S17	$15	-.09%	512	1973	**.07%**	383	1434

Table 13: Lowering your bet spread to play longer

The 'Rounds' columns represent the average number of rounds before doubling or losing the listed bankroll; divide this by 100 to get an approximation for the number of hours of play will you achieve. Since the expectations are all pretty close to zero, there is not a lot of difference between the rounds to failure versus the rounds to success. The games with positive expectation are highlighted.

There are some interesting observations we can make from this data:

- We assumed a higher $15 table minimum for the 6 deck games. As a result, the longevity was reduced almost by a factor of 10 for both the $500 and $1000 bankrolls.
- Expecting to last a long time at a $15 minimum table with a $500 bankroll is not wise. You are not likely to play for more than 4 hours before doubling or losing your bankroll. With these very marginal expectations, your ROR is between 50% and 70% for the negative expectation games, and between 47% and 50% for the positive games.
- Whether these near-zero expectation games are positive or negative has little affect on your playing time.

We didn't list single deck games since they already use a 1 to 3 bet spread, and generally require much higher minimum bets of $25 or more. As such, your playing time is going to be even worse than the six deck games above given such small bankrolls.

So, if you are looking to maximize your playing time, we recommend you seek out the best multi-deck rules (DAS, S17), minimum $5 bets, and use a 1 to 3 bet spread. You will get 30 or more hours of playing time with a very modest $500 to $1000 bankroll. You are basically going to play even with the house, but you can play knowing there is little chance of losing your bankroll in short order.