Worldwide Casino Consulting, Inc.

Can Baccarat be Beaten

By

Card Counting

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CAN "BACCARAT" BE BEATEN BY CARD COUNTING

Both Baccarat and the game of 21 (Blackjack) are dealt from decks of cards which are not shuffled after every hand. This fact creates dependent gambling trials. The known cards played in previous hands give an indication of the relative make-up of the cards remaining to be played. Casino games such as Craps, Roulette and the Big Six are games of independent trials. The last number the ball landed on in a Roulette Wheel does not affect any other spin of the wheel....no one spin of the ball is dependent on any other spin. The same holds true in a crap game. The odds of rolling an eleven are 2 chances out of the 36 possible two number combinations that can be made with a pair of dice. The eleven can be made with a 6 on one cube and a 5 on the other or vice versa. Any other numbers rolled before an eleven shows are inconsequential to the odds of throwing an eleven. The odds are 2/36th or 1/18th....18 to 1 against....This is an independent event.

No matter how many elevens are rolled in succession the odds for the next eleven are still 18 to 1 against. Although independent events for games like Blackjack can be computed, they are just theoretical mathematics. Take for example the chances of being dealt a Blackjack in a single deck game. The mathematics for this event looks like this...

$$\frac{(2 \text{ X } 4 \text{ X } 16)}{(52 \text{ X } 51)} = \frac{128}{2652} = 0.0482654 = 0.0483$$

The math is very straight ahead...The "2" implies that an Ace or Ten could be had on either the first or second card...The "4" is the number of Aces in a single deck...The "16" is the number of Ten value cards..."52" is the full deck of cards and "51" is the number of cards after the first card dealt. The probability of being dealt a Blackjack is 0.0483 or 4.83%. This means that on average a Blackjack will occur once every 21 hands. That’s the theoretical mathematics of an independent trial or event. Suppose though in the real world that in the first go round of play in a single deck game all four aces are dealt...with no Blackjacks.

The odds now are "zero" of a Blackjack being dealt until after the next shuffle-up. Conversely, let's suppose that twenty-six cards are dealt from a single deck and no aces or tens are dealt. The odds of a Blackjack occurring are now dramatically increased. The math looks like this...

$$\frac{(2 \times 4 \times 16)}{(26 \times 25)} = 0.1969231 = 19.69\%$$

The odds of being dealt a Blackjack have increased in this situation to approximately 19.69% or about 1 chance in 5. The dependent events (dealing 26 cards without an ace or ten showing) have affected the independent question of the probability of a Blackjack being dealt. For your information, a hidden card count computer used by Blackjack players make these types of calculations on an ongoing basis during play.

There are several so-called betting "systems" which purport to offer an advantage in casino gambling games. Given that most games are a series of independent trials I prefer to call these systems....betting methods. The simplest of all betting methods is the Martingale. The method calls for you to double up when you lose. A $5.00 loss means a $10.00 bet on the next wager. A loss of that $10.00 bet means a $20.00 wager on the next bet and so on. The problem with any type of Martingale method is the customer, attempting to win the amount of the first wager in the progression, runs into the table limit.
Extending, the above Martingale progression would look like this;

#	1	2	3	4	5	6	7	8	9	10	11
$	5	10	20	40	80	160	320	640	1280	2560	5120

On a game with a $5,000.00 limit the customer could not make the 11th bet in the progression. Keep in mind that the player has already lost the sum total of the first ten bets...($5,115.00)....he would need to risk an additional $5,120.00 wager in order to win $5.00. On a $5.00 to $500.00 game, you couldn't make the eight wager, $640.00. (You can expect to lose 7 times in a row approximately once every 87 hand sets…approximately once every 7 hours)

A cancellation betting method is a little more intriguing. A series of numbers is used such as the following;

10 20 40 60 80

The first bet is the sum of the two outside un-cancelled numbers............. in this case......10 + 80 = 90. If the bet should lose, the two outside numbers are canceled and their total is added to the end of the list.

(10) 20 40 60 (80) 90

The next bet is the sum of the two outside un-cancelled numbers.......in this case.....20 + 90 = 110....and so on.

The ability to remember and correctly negotiate simple addition may make the user of this method a "wonderful forth grade student"....but it in no way affects the future outcome of an independent trail game like Roulette or Craps. These types of betting methods give the inexperienced player a sense of security. They are not just guessing, but rather have a method to determine their betting strategy. The betting strategy, (however simple or complex) does not evolve from any dependency on previous events or gambling trials. Adding two numbers or doubling the previous bet does not affect the 5.26 percentage of advantage against a player on a roulette table. In reality, the player is simply placing a larger bet with the same mathematical disadvantage.

In games of dependent trials such as twenty-one, the doubling of a losing bet may, in fact, put the wager at greater risk because of the cards previously played. (The betting method may call for you to double a wager at a time when the remaining cards have a positive expectation for the house.) The amount of the wager is not arrived at by any mathematical involvement in the gambling process. A player using a betting method feels secure because they add structure to an otherwise random pattern of attempting to "out guess" the gambling game or "hunch" bet.

The game of twenty-one offers a mathematical model by which all other games of dependent trials can be evaluated. Twenty-one card counting very simply runs a ratio of big cards (10's and aces) to little cards (2,3,4,5,6). When the ratio is lopsided in favor of big cards, meaning an abundance of big cards remaining in the shoe to be played, the player has the advantage. Mathematically speaking, the player and dealer have the same chance of receiving the same first two cards and thereafter achieving the final totals. The advantage to the player is derived because of the 3 to 2 payoff for Blackjacks, (obviously more plentiful due to the abundance of big cards.) Double Down wagers and Insurance bets are also enhanced by higher card values. Also, because the house hits last and must fall into a window of between 17 and 21, the big cards have a tendency to take the count over 21. When the ratio of big cards to little cards is lopsided in favor of little cards, meaning an abundance of little cards remaining in the shoe to be played, the house has the advantage. There will be far less Blackjacks due to the abundance of little cards. The Double Down and Insurance wagers are now less profitable for the players. Because the house hits last and must fall into a window of between 17 and 21, the little cards have a tendency to keep the count between 17 and 21. Very simply, when the count is plus (big cards left) the player makes "plus" bets, conversely, when the count is minus (little cards left) the player makes "minus" bets. Any count between a plus and minus is considered a "flat" count and indicates "flat" bets. The plus/minus count is a system which is dependant on the gambling process. The card counters' playing and betting strategies are determined by a direct correlation with the cards previously seen in play. This is an over simplification of the complex question of card counting. However, the theory of card counting says that a player will lose more hands in any given play than they win. Because the card counter recognizes the mathematically advantageous makeup of the remaining cards, larger wagers are won more often. Understand that the dependent nature of the game of twenty-one allows for a card count system and basic strategy method of play to be effective in identifying the relative strength of dependent trials that occur throughout the model. In the previous example where 26 cards were played and no "Aces" were dealt, the probability of a Blackjack being dealt increased dramatically. The net result however does not impact both hands (the dealer and player) equally.

The dealer and player each have the same mathematical chance of achieving the Blackjack…(without cheating, no system can determine which hand will receive which cards.) When however, the relative make up of the remaining cards is "Ace Rich", the player has the advantage in terms of money. If the dealer receives the Blackjack the house takes "Even" money from the player. Under the same conditions when the player receives the Blackjack, they are paid 3 to 2...... called "Time and a Half". When the dealer receives two aces he cannot split his hand and take twice the player's money. The player however being dealt two aces can split the pair and double the money with two strong cards. The same analogy holds true for doubling down on soft hands. The probability of the independent event is the same for both sides but the relative make up and strength of the remaining cards ("Ace Rich" configuration) allows the wager to be exploited by the player.

The question is, given that baccarat is a game of dependent trials, shuffled and dealt similarly with eight decks, does a card count or betting system exist which identifies the mathematical advantage at any time for either the player or banker sides and allows that advantage to be exploited.

As you know, there is no time in the game of Baccarat where-in the customer or house ever has the option of asking for or refusing a card. The rules of the game call for the cards to (in effect) play themselves. This is known as a strategically static game…as opposed to Blackjack which is a strategically dynamic game. The minimum number of cards that will be dealt in any one Baccarat hand is four (4)....the maximum number of cards that can be dealt is six (6). It would be a monumental task to attempt to analyze all possible six (6) card subsets for an eight (8) deck Baccarat game.

The total number of possible six card subsets is as follows;

$$\underline{(416)\,! = 6{,}942{,}219{,}827{,}088}$$
$$(6)$$

Further, each subset would have to be looked at in all possible combinations; that looks like this...........

$$\underline{(6) \times (4) \times 2 = 180 \quad \times \;(6{,}942{,}219{,}827{,}088)}$$
$$(2) \times (2)$$

The above calculations of course take into account the four different suits and the card values 10, jack, queen & king....all of which are irrelevant to the game of Baccarat. The simplest of all six (6) card subsets to consider is one in which all six cards are the same value. Suppose that the six remaining cards to be dealt in a Baccarat hand were 2 - 2 - 2 - 2 - 2 - 2. You would of course know that the resulting hand would be a "Tie"....6 - 6.

It is however, an academic question to analyze six card subsets because this assumes there are times when a Baccarat shoe will be dealt down to six cards. This is an unlikely (almost impossible) occurrence except through dealer error. If, however a six-card subset was encountered, (without knowing the exact order of the cards) then the following chart represents the advantage gained for each side;

SIX CARD BACCARAT SUBSETS

WAGER	CHANCE IT IS FAVORABLE	AVERAGE EXPECTATION	EXPECTATION PER HAND PLAYED (%)
"PLAYER"	.150967	3.20	.4831
"BANK"	.270441	3.26	.8818
"TIE"	.339027	72.83	24.6909

Understand the above chart makes the very broad assumption that a dealer will mistakenly or intentionally deal past the cut card. There is still no guarantee that a six-card subset will be produced...given that the "Pad" created in a Baccarat shoe is fourteen cards, the average ending subset is between eight and fourteen cards.

For your information I am including the relative expectations for various numbers of card subsets. They are as follows;

PLAYER & BANKER BETS
(COMBINED)

NUMBER OF CARDS	CORRELATION	OPPORTUNITY (%)
10	.64	.24(.07)
13	.74	.12(.04)
16	.78	.09(.02)
26	.89	.03(.004)

As you can see, a relatively small increase in the number of cards in a given subset dramatically reduces the percentage of opportunity to engage any type of mathematical advantage however derived......(intuitively or via the use of a hidden computer.) Also understand that from a purest standpoint the above numbers vary slightly from Player to Banker. The variance is so minute as to be insignificant to the overall question so the set of numbers above can be considered valid for both sides.

The number of cards in a given subset is only one issue to be considered in the Baccarat/Card Counting question. Far more significant and practical are the card values played and what (if any) indications they give about the relative make up of cards left to be played. As you know, in a 21 game card counters use a weighted numeric index to assign value to each card relevant to its potential strength or weakness as it regards the dealer's possible hand totals.

A simple weighted scale is used to maintain a ratio of big cards to little cards. Basic, mid-level and advanced 21 card count scales are represented in the table below;

CARD COUNT VALUES

	2	3	4	5	6	7	8	9	10	ACE
Basic	1	1	1	1	1	0	0	0	-1	-1
Mid Level	2	3	3	4	3	2	0	-1	-3	-4
Advanced	5	6	8	11	6	4	0	-3	-7	-9

As each card is played in a 21 game the numeric value (for which ever system) is added or subtracted, starting from zero, to gain a simple "Running Count". The count continues from hand to hand and the relative strength of the remaining shoe is determined. The "Plus" or "Minus" value arrived at also indicates the amount of the next wager for a card counter. The simple running count is converted to the "True Count" by dividing the number of cards left to be played into the simple running count. This conversion from running count to true count takes into account the number of cards left to be played. (A running count of +6 is much stronger with only two decks left to be played versus the same running count of +6 with five decks remaining. Therefore, the conversion process from simple running count to true deck count.) For your information every 0.5 point of true count indicates one unit of wager...a true count of +3 equals a 6-unit bet. A card counter needs a True Count of +3 or greater in a six (6) deck game to increase his wager. (Note: For every +1 point of True Count the player gains Approximately 0.5% advantage.)

Similar numerically weighted indexes have been developed for the game of Baccarat. The most advanced work being done by Peter Griffin and Ed Throp. The following table shows the "Ultimate Point Count" for Baccarat.

Card Value	Player Bet	Banker Bet	Tie Bet
Ace	-1.86	1.82	5.37
2	-2.25	2.28	-9.93
3	-2.79	2.69	-8.88
4	-4.96	4.80	-12.13
5	3.49	-3.43	-10.97
6	4.69	-4.70	-48.12
7	3.39	-3.44	-45.29
8	2.21	-2.08	27.15
9	1.04	-.96	17.68
10,J,Q,K	-.74	.78	21.28
Full Shoe %	-1.23508	-1.05791	-14.3596

The Baccarat count is used in much the same manner as a 21card count. The significant difference is that both the Bank and Player sides can be evaluated but with different numeric values. Let's suppose the first hand of a Baccarat shoe was a 3 & 4 for the Player's side and a 9 & Jack for the Bank. The simple running count for the Bank side expectation is as follows;

3 4 9 Jack
2.69 + 4.80 - .96 + .78 = +7.31

Although +7.31 seems to be a significant positive advantage for the next Bank side wager, the simple running count needs to be adjusted for the number of cards left to be played and the Full Shoe % expectation in the table above. The true count expectation is as follows;

-1.05791 + (2.69 + 4.80 -.96 +.78) / (412) = -1.04016% (Bank Side)

Similarly, the Player's Side expectation can be estimated;

-1.23508 + (-2.79 - 4.96 + 1.04 - .74) / (412) = -1.25316% (Player Side)

The expectation for the Tie bet in this example would be;

-14.3596 + (-8.88 -12.13 + 17.68 + 21.28) / (412) = -14.3160% (Tie Bet)

The number 412 used in the above examples is the number of cards left to be played after the four cards used in this first hand. (Eight decks of cards = 416 cards....minus the four cards played = 412.) This number is slightly misleading in light that at the beginning of a Baccarat game the first card of the shoe is turned face up and whatever its' value, a similar number of cards are "Burned"..... discarded without their value being seen. In all the above examples even though the Baccarat "Running Count" was high, the "True Count" still showed a negative expectation for all three bets.

In order to put the question to rest, similar evaluations can be made for the most advantageous, (yet nearly impossible) condition. The cards whose removal yield the strongest positive expectation for the Player side wager are the fives, sixes and sevens. (In an eight-deck shoe there are 32 each of the fives, sixes and sevens...96 cards total.) Assuming the first 96 cards dealt were all of the fives, sixes and sevens......depleting the eight decks of all 5's, 6's and 7's.....the expectation for the next Player Side wager would be as follows;

-1.23508 + 32(3.49 + 4.69 + 3.39) / (320) = -.078%

Obviously, the conditions above could never occur in actual play. The calculations show however the futility of counting down even the most advantageous conditions and expecting positive results.

Assuming the opposite side of the argument, which is using the count to determine the least negative expectation rather than waiting for a positive count to occur yields similarly futile results.

Taking this posture would improve the negative expectation on the Bank Side wagers by an average of 0.09%. This reduces the negative expectation on the Bank Side from -1.06% to -0.97%.

Understand this proposition implies that you place the same average wager on every hand, make all the necessary calculations and chose the side with the least negative expectation...and still you will lose at a rate almost equal to "Pure Chance" minus approximately 1.0%.

(From an academic standpoint, a hidden body worn computer could easily be utilized to perform the necessary calculations. The use of any electronic device to predict the future outcome of a gaming event is of course illegal. From a practical standpoint however because of the speed at which a Baccarat game is dealt...(very slowly)...the same calculations could be made by hand on the scorecard supplied to each customer as they are seated. Many Baccarat shuffle-up scams have been accomplished by recording cards with nothing more than the scorecard and pencil the house supplied.)

All available data shows that the ultimate point card count for Baccarat is worthless under virtually all conditions to predict a positive expectation for the Tie Bet.

From the absolute purest point of view, the numerically weighted Baccarat point count can indeed identify those times when a positive expectation can be gained. Below is a representation of the Baccarat Card Count program I developed in the mid 1980's for use in analyzing Baccarat wins or losses in a casino;

****

<<<< B A C C A R A T C A R D C O U N T >>>>

Developed by George D. Joseph

Enter Cards…0,1,2,3,4,5,6,7,8,9…As You See Them Played
Press (S) For Reshuffle…..Press (E) To End

****

RUNNING COUNT

Player	Banker	Tie	Shoe	Card Dealt	Cards Played
-7.45000	7.31000	17.95000	412	0	4

****

TRUE COUNT

Player	**Banker**	**Tie**	**Shoe**	**Card Dealt**	**Cards Played**
-1.23516	**-1.04017**	**-14.311603**	**412**	**0**	**4**

****

(Next…70 cards played….with an abundance of 10's & 1,2,3 played)

****

<<<< B A C C A R A T C A R D C O U N T >>>>

Developed by George D. Joseph

Enter Cards…0,1,2,3,4,5,6,7,8,9…As You See Them Played
Press (S) For Reshuffle…..Press (E) To End

****

RUNNING COUNT

Player	Banker	Tie	Shoe	Card Dealt	Cards Played
-108.36000	107.27000	514.64030	346	3	70

****

TRUE COUNT

Player	**Banker**	**Tie**	**Shoe**	**Card Dealt**	**Cards Played**
-1.54826	**-0.74788**	**-12.87220**	**346**	**3**	**70**

****

As you can see, the Running Count does in fact show a Bank Side advantage, however the True Count still shows a negative expectation for both sides. (I suppose you could look at the proposition as, "I know when I have less than the theoretical disadvantage.") (Next see an anomaly, Bank Side positive;)

(228 cards played….with an abundance of 10's & 1,2,3 played)

****

<<<< B A C C A R A T C A R D C O U N T >>>>
Developed by George D. Joseph

Enter Cards…0,1,2,3,4,5,6,7,8,9…As You See Them Played
Press (S) For Reshuffle…..Press (E) To End

****

RUNNING COUNT

Player	Banker	Tie	Shoe	Card Dealt	Cards Played
-204.37010	204.10010	1307.452000	188	4	228

****

TRUE COUNT

Player	**Banker**	**Tie**	**Shoe**	**Card Dealt**	**Cards Played**
-2.32216	**+0.02773**	**-7.40507**	**188**	**4**	**228**

****

However, a major assumption must be conceded for this to be the case. The casino would have to allow a customer to sit out for long periods of time without wagering at all. The customer would utilize the point count and wager only at those rare times when a positive expectation is calculated for either the Player or Bank side. The average expectation gained under these unrealistic conditions would be approximately 0.07%. Assuming a one-hour time frame to deal a Baccarat shoe and also assuming a $1,000.00 bet the net profit from this proposition equals 70 cents per hour. Extensive simulations further suggest that theoretically the positive expectations under these conditions may only arise three times out of every eight shoes. A player would then sit at the Baccarat table and place three wagers in eight hours with a net expected return of $2.10 for the three $1,000.00 wagers.

UPDATE 2020: For completeness' sake, I've added an updated program which also analyzes various popular Baccarat Side Bets and Whole Number Bacc Counts.

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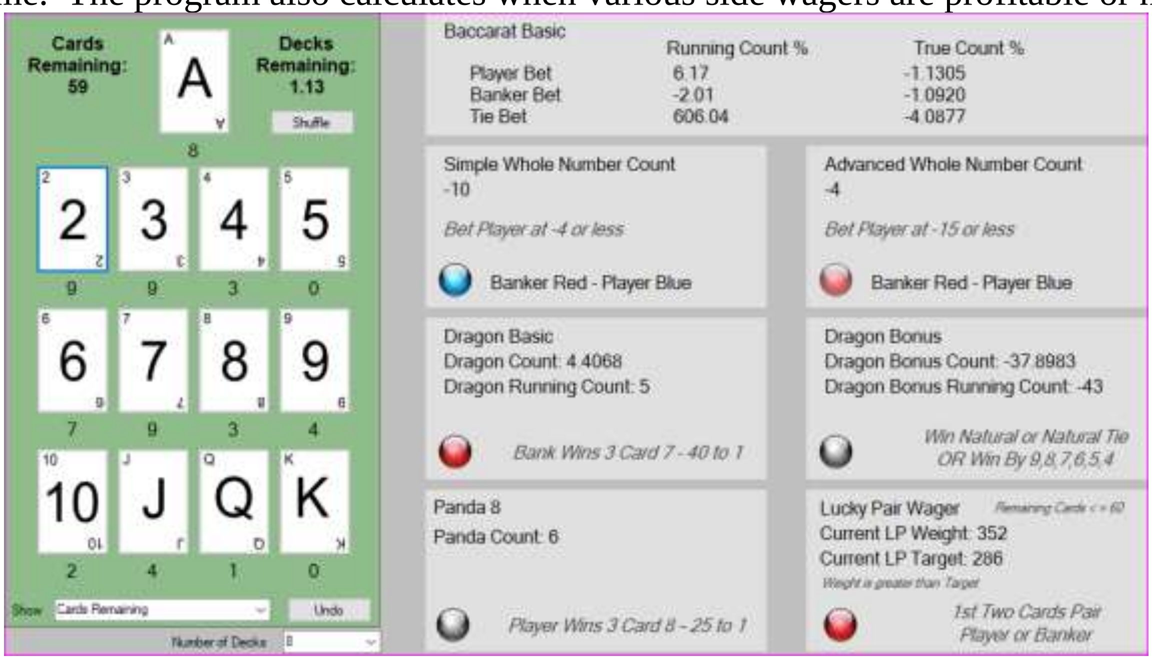
The program above calculates the Running & True Counts for a standard Baccarat game. The program also calculates when various side wagers are profitable or not.



Surveillance only has to enter each card played. The various Baccarat Side Bets are only positive for the customer when the Red Light alerts. Whole number Baccarat Counts (which can be accomplished in the head) are also calculated.

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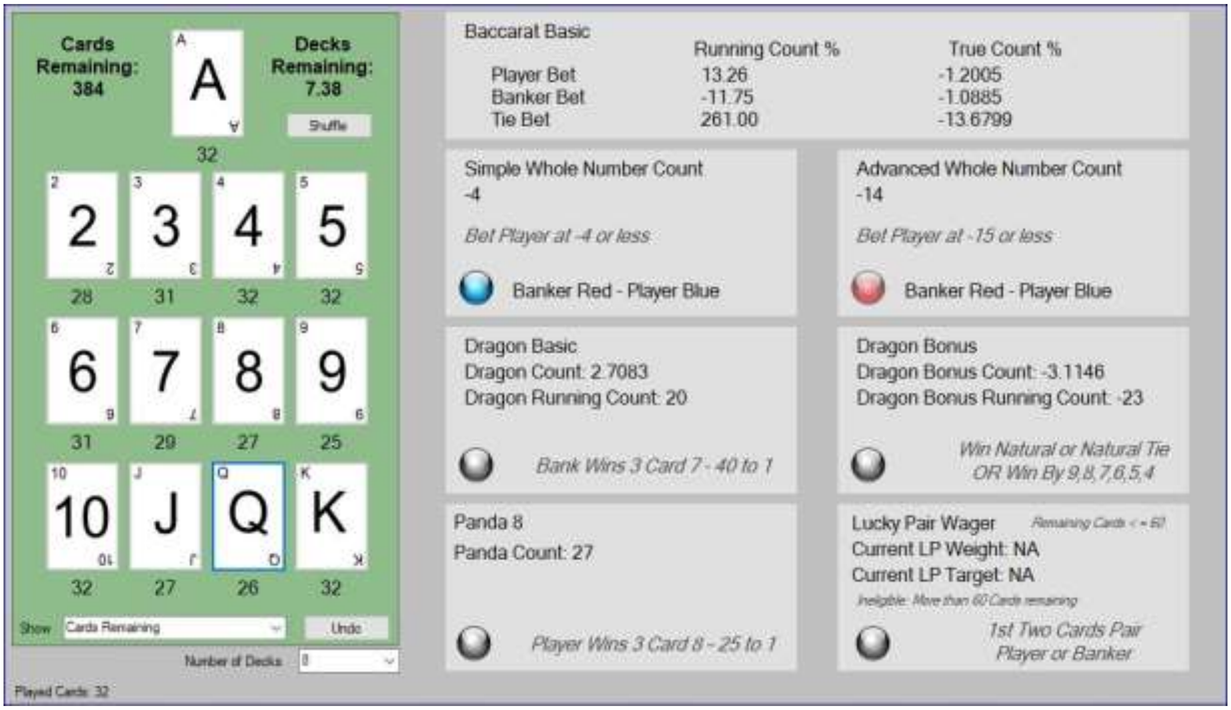

The Simple & Advanced Whole Number Counts calculate which side has the least disadvantage. This element should not be overlooked when considering an analysis of Baccarat Profitability including customer comps, free bets or match play coupons, commissions and all related expenses.

I will be discussing Baccarat Side Bet Card Count programs in a separate report. Far more dangerous are the many attempts at cheating at Baccarat and the various forms of advantage play which will be addressed in future papers.

Respectfully Submitted,

George D. Joseph
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