

THE STORY OF LOUISIANA BACCARAT

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New Game entry at Global Table Games Conference, Las Vegas April 2023

INTRODUCTION

This is the story of how I addressed the question: How can Baccarat be improved?

It is an impertinent question. Baccarat is the biggest gambling game in the world: it ain't broke!

And yet....

There are some issues with Baccarat that make it forbidding for some players, annoying for others, and difficult for casinos. The rules are rigid and complicated. Players have no strategic choices to make. It can be slow. And a whole culture has built up around baccarat play, that "big players" care about and are used to, which must be taken into account.

I didn't set out to remake Baccarat. I'm a mathematician. I was just trying to apply some fancy academic Game Theory that, in my years in the industry, I had noticed was never applied in any real casino games. Professional poker players knew some of this theory, but they used it against other players in sophisticated ways. I wanted to use it to improve regular table games for ordinary players. Some of you have seen my earlier attempts at the old Cutting Edge conferences.

As I have continued these efforts, a few core themes have kept recurring.

- 1) Transparency. The essence of a game must be easy to grasp. There should be no weird rules or gimmicks or obscure terminology.
- 2) Fairness. Players like to feel that they have a fair shot to win: that the game isn't slanted against them in favor of the House. This is quite hard to accomplish! When games are played against pay tables, everyone knows the numbers have been chosen to give the house an edge, and players won't have great intuition about how much of an edge. When games are some kind of contest between Player and Dealer, the contest is usually "gaffed" in an obvious way. For example, in Blackjack, there is one big advantage in favor of the Dealer (if both bust, Player loses), which is compensated for by lots and lots of little advantages for the player that make the game fun, but which don't quite add up to enough to come out ahead over time. (And Blackjack is the best here, with the smallest House Edge of all casino games. Other games have more blatant asymmetries favoring the House.)
- 3) Novelty. You want the game to be new and interesting, but not too much! If it doesn't resemble anything players are used to, they won't know how to play it, and will lose money quickly and quit.
- 4) Dealability. This is an underrated criterion. If the game is difficult to implement or if operational issues arise, casinos will shut it down quickly. Complicated House Ways,

needing special decks of cards or other equipment, too many rounds of betting which slows play down, vulnerability to advantage play, can all result in a “failure to launch”.

The main insight that I take credit for, which other game designers have not taken advantage of in any significant way, is that it is possible to use mathematical game theory to build in House Edges to games that are apparently completely symmetrical and fair. Without gimmicks or gaffs, one can use the concept of *positional advantage*: the player and dealer do the same things and the rules for winning are symmetrical, but someone has to go first!

Poker players know this, but they don't care: in some games it's a strategic advantage to go first because of initiative, in other games it's a strategic advantage to go last because of information, but the “button” moves around the table and everyone gets a chance in all positions.

In Player vs. Dealer table games that's no longer true! The roles are fixed, so an advantage can be built in, but the “House Edge mechanism” is much subtler and unnoticeable to players.

But wait... Baccarat, like Roulette and Craps and unlike Blackjack and most “Carnival Games”, is a game of chance not a game of skill. Players make no choices. That's why many of the big players like it—it doesn't matter if they're too drunk to figure out the right move, it's all luck which will still follow them. If there's no strategy, how can the game theory be relevant?

The answer is – Baccarat is a *frozen* game of strategy. It came from an older game where players faced off on an equal footing and had a choice about whether to take a third card. The complicated Banker 3rd card rules are just the residue of the optimal strategy in the version of that game where the third card had to be taken face up, giving the second player an informational advantage.

But I had done some mathematical investigation, and proven some theorems about a simple abstract game of strategy, and I recognized what nobody else seemed to have noticed: MOST of the Banker advantage in Baccarat comes not from seeing what the Player hand's 3rd card is, but simply in knowing whether the Player took a 3rd card at all.

This is the key insight that unlocks a host of other improvements to the game. If the Banker doesn't need to see the third card, only to hear whether the Player asked for one, a blind banker could do just as well (in fact, my original name for this game was “Blind Banker Baccarat”). After the first 2 cards for each side, it can be already determined whether the Banker as well as the Player will take a 3rd card. They can both be dealt at the same time, or in the opposite order, and the game will still work.

How does this all work out? Well, let's take a mathematical detour. If you don't care about math, just skip the next section!

MATHEMATICAL DETOUR

Why is Poker more fun than table games?

I'm not talking about the social aspects, or the psychological part of it, just about the mechanics of the game itself.

As far as I could tell, there were several aspects of poker play that are not well reflected in player vs dealer table games:

- 1) Fairness and symmetry – same rules for player and dealer, if there even is a dealer
- 2) Strategy around improving your hand, by drawing or discarding some or all of your cards
- 3) Strategy involving the way you bet: not simply maximizing or minimizing it depending on whether your hand is good or bad, but in some way pressuring the other player
- 4) A special subcategory of 3: bluffing.

So I boiled down Poker to the simplest possible purely mathematical game. Instead of a “hand” involving several cards, you just get a number between 0 and 1.

BABY POKER: You get a number. The other guy gets a number. Higher number wins. Wheee!

Well, this is sort of boring, although they based a game on it called Casino War, about which, the less said, the better. But can we import more features of Poker?

BABY STUD: You ante. The other guy antes. You each get a number. If you like your number, you raise! He can call or fold. If you don't like your number, you check, then he can check, or he can raise and you can call or fold.

This turns out to work! In the simplest case, where the raise must equal the ante, the game-theoretic optimal strategies are as follows:

First player: check between $1/9$ and $2/3$, otherwise raise. If you checked and get raised, fold with less than $1/3$, otherwise call.

Second player: If raised, fold with less than $1/3$, otherwise call. If checked to, check between $1/6$ and $1/2$, otherwise raise.

Wait, what? Raise with a low hand? You should bluff?

Yep. The second player has an advantage of $1/18$ of an ante, or 5.56%. The first player is raising $5/9$ of the time, and calling $2/9$ of the time, average bet $16/9$, so his disadvantage is $1/32$ of his total bet, or 3.125%.

Hmmm, that looks like a House Edge....

As some of you have recognized, this led to my game “Bluff”, presented here a few years ago, which was ready for its field tests when the pandemic hit, and has since been further improved. But I'll spare you the proof of the math, because the next game has much cooler numbers!

BABY DRAW: You get a number. If you don't like it, you can have a new one instead. Then the other guy gets his number, and his own chance to discard and redraw. Higher number wins!

That's all? This is interesting?

Well, yes. Let's think about the strategy here.

If you drew, he knows that you have a totally random number between 0 and 1 now, so if he also draws it's a tossup but if he has over 1/2 he is likely to win, so he should stand.

If you stood pat, you probably have a better than average hand, so his cutoff for drawing will be higher than 1/2. But how much higher? And how high is good enough for you to stand?

(There's no bluffing here because there's no such thing as folding.)

This is a cute algebra and calculus exercise. If player 1 stands on $> x$, and player 2 stands on $> y$ if player 1 stood and $> 1/2$ if player 1 drew, it's not hard to see that $1/2 < x < y$. Let's calculate the probability player 1 wins. Here are the cases:

Player 1 has $< x$, player 2 has $< 1/2$: both will draw, tossup, total win probability is $1/2$ times the probability $x/2$ of this case, or $x/4$.

Player 1 has $< x$. player 2 has $> 1/2$: 1 draws, 2 stands, 1's chance of winning falls uniformly from $1/2$ to 0 as player 2's number goes from $1/2$ to 1, averaging $1/4$, total win probability is $1/4$ times $x/2$, or $x/8$.

Player 1 has $> x$, player 2 has $< y$: 1 stands, 2 draws, 1's chance of winning rises uniformly from x to 1, averaging $(1+x)/2$, total win probability is this times the probability of this case, or $(1+x)(1-x)(y)/2 = y/2 - (x^2)(y)/2$

Player 1 has $> x$, player 2 has $> y$: 1 and 2 both stand. If player 1 has $< y$, he loses, so the only win probability comes from when they both have $> y$ and stand, and it's half the area $(1-y)^2$ or $1/2 - y + (y^2)/2$.

Put it all together and what do we get? $3x/8 - y/2 - (x^2)(y)/2 + (y^2)/2 + 1/2$

If you remember Calculus 2, we are looking for a "saddle point" of the surface representing this function of x and y , because x is chosen to maximize it and y is chosen to minimize it. So we take partial derivatives and set them equal to 0!

Fix y , take the derivative of x : $3/8 - xy = 0$

Fix x , take the derivative of y : $-1/2 - (x^2)/2 + y = 0$, or more simply $x^2 + 1 = 2y$

From the first equation, $xy = 3/8$ so $y = 3/8x$. Substitute and multiply through by x to get:

$$x^3 + x = 3/4$$

A cubic equation. YUCK!

Well, it's actually a relatively easy one. There is a cubic formula, here is what it gives:

Cubic formula: if $x^3 + 3px = 2q$, then $x = \sqrt[3]{q + \sqrt{q^2 + p^3}} + \sqrt[3]{q - \sqrt{q^2 + p^3}}$

Our equation is already almost there! We just note $p = 1/3$ and $q = 3/8$ and plug, to get

$$x = \sqrt[3]{\frac{3}{8} + \sqrt{\frac{307}{1728}}} + \sqrt[3]{\frac{3}{8} - \sqrt{\frac{307}{1728}}}$$

This works out to $x = 0.567364\dots$

Sure, we could have solved it by numerical iteration, but what fun is that?

Going back, we get $y = 0.660951\dots$ and a final win probability of $0.4943334\dots$

That's awfully close to 0.5. I guess that extra bit of information of knowing whether the first player stood pat isn't worth very much, the win-loss difference is just $0.0113332 = 1.133\%\dots$

Gee, what kind of a game has THAT House Edge?

BACK TO BACCARAT!

Okay, if you skipped the math, we figured out that in a game where one player can either keep his hand or randomize it, and then the other player can keep HIS hand or randomize it, the second player has an advantage of about 1.1%.

Isn't this what's happening in Baccarat?

Well, not exactly. If you take a card you don't *totally* randomize your hand, but it's close enough—a face card doesn't change anything and the other 10 types of card spread your score out to all possible values. And if someone gets a “natural” 2-card 8 or 9, the game ends without further cards: this happens about 1/3 of the time. That reduces the Banker advantage, but there's a compensating increase in the Banker advantage because the Banker hand's choice depends on what the Player hand's 3rd card is.

I'm sure most of you have seen the following chart:

Baccarat Drawing Rules										
Banker's Score	Player's Third Card									
	0	1	2	3	4	5	6	7	8	9
7	S	S	S	S	S	S	S	S	S	S
6	S	S	S	S	S	S	H	H	S	S
5	S	S	S	S	H	H	H	H	S	S
4	S	S	H	H	H	H	H	H	S	S
3	H	H	H	H	H	H	H	H	S	H
2	H	H	H	H	H	H	H	H	H	H
1	H	H	H	H	H	H	H	H	H	H
0	H	H	H	H	H	H	H	H	H	H

But do we need this? If we apply the logic from the “BABY DRAW” game I analyzed, the Banker should be standing on better-than-average hands if the Player randomizes. 5 is better than average! (4 better hands, 5 worse hands) And if the player stands on 6 and up, and hits on 5, then if he’s standing the Banker had better be hitting on 5 or he’s surely losing.

What’s the net effect here? In the table, the top 6 “H’s” become “S’s”, and the bottom 5 “S’s” become “H’s”. That’s so simple we don’t even need a table any more!

The new rule is: Banker hits 0-4, stands 6 and up, and on 5 does the opposite of what Player did.

This is going to reduce the Banker’s advantage with an 8-deck shoe to...

0.774%.

Hmm. Can we get away with this? It’s sorta small (though still bigger than in Blackjack).

The answer is – of course we can! The game is better for the Player than before, but we know that Standard Baccarat is better for the Banker and a comparable amount of money is still placed on “Player”. What matters is the AVERAGE of the Player and Banker House Edges.

That depends not on the Player House Edge, but only on what you do to take money away from the Banker. If you take the standard 5% commission, it’s just about the same on average.

Standard Baccarat Banker wins 45.86% of the time, House takes 5% of a bet which is 2.5% of the total bet if Player action equals Banker action, giving an average of 1.146%. House Edge is 1.235% against Player, 1.058% against Banker.

Simpler Baccarat: Banker wins 45.67% of the time, House takes 5% of a bet which is 2.5% of the total bet if Player action equals Banker action, giving an average of 1.142%. House Edge is 0.774% against Player, 1.509% against Banker.

1.142% vs 1.146% seems close enough!

OK but the trend is to move away from commissions, can we fix that? We need an event that occurs infrequently, that is an occasion for penalizing the Banker hand, so that instead of taking 5% of the Banker's winnings every time, we take much more, but much less often.

Here's another place to look for simplifications and improvements. The two main ways Standard Baccarat is implemented "Commission Free" are as follows:

EZ Baccarat has the Banker hand push if it wins on a 3-card 7. This loses 1 unit for the Banker, 2.253% of the time, converting his natural 1.235% advantage over Player to a 1.018% disadvantage. The average of the two numbers is 1.127%.

The other variation has the Banker hand only pay 1 to 2 if it wins with a score of 6. This loses 0.5 units for the Banker, 5.386% of the time, converting his natural 1.235% advantage over Player to a 1.458% disadvantage. The average of the two numbers is 1.347%.

The most annoying thing about these rules is that the Banker is denied the full value of his win in an arbitrary way. Psychologically, maybe we should pay all wins in full? The Banker is still getting his chips back in the event of a tie, is there a tie that happens about 2% of the time?

There sure is. A 7-7 tie occurs 1.997% of the time under the simplified rules. If that occurrence leads to a loss for the Banker hand instead of a push, the Banker's disadvantage becomes 1.223%. Averaged with the player's disadvantage, we get 0.999%, call it 1%. This looks viable!

The beauty of this rule is that, not only does the Banker get paid in full for all wins, the "negative event" happens less often, and furthermore it *appears* to happen WAY less often!

7-7 is only one score. In EZ Baccarat, there are 7 different scores that lead to the Banker pushing what would have been a win: 7-6, 7-5, 7-4, 7-3, 7-2, 7-1, 7-0. It's true that we are looking at this tie with both 2- and 3-card Banker 7s, not just 3-card Banker 7s, but it's still intuitive to the player that he gets that twinge of annoyance less often. It's really only a little bit less often, but it seems like it ought to be a lot less, so the Banker bet looks better.

What else looks better? How about the Tie Bet? In Standard Baccarat, a tie occurs 9.52% of the time, giving a House Edge of 14.36% for the usual 8 to 1 payout. In our game, the tie happens 9.43% of the time, with a House Edge of 15.10%. Ugh, that's worse; but what the heck is the point of even a 14.36% House Edge? You'd have to be crazy to make that bet! Let's bring it up to 9 to 1, maybe even call it "10 for 1" which sounds better and avoids confusing it with the Standard Baccarat tables where the Tie bet is advertised as "9 for 1". The House Edge becomes 5.671% -- still a healthy size for the casino. Of course, we'll need a lot more players taking the Tie bet for this to be more profitable, but I think they will successfully NOTICE how much of a better deal it is.

Suddenly this game is looking better all around. We can even make it better for the Banker in the Commission version of the game by taking only 4%, which works nicely with \$25 chips, bringing the House Edge against Banker down from 1.509% to 1.053%.

LET'S IMPROVE EVERYTHING!

Actually, we're just getting started with the improvements. What else happens in a Baccarat game?

Side Bets! When Mike Shackleford came up with pay tables for the Dragon Bonus side bet, it allowed a Baccarat player to get a big payout—bigger than the Tie bet could give, without the horrible House Edge. The idea was to award more if the side you bet on wins by a lot. Let's see how this works:

Naturals	
Natural winners pay	1 to 1
Natural ties	Push
Non-Naturals:	
Win by 9 points	30 to 1
Win by 8 points	10 to 1
Win by 7 points	6 to 1
Win by 6 points	4 to 1
Win by 5 points	2 to 1
Win by 4 points	1 to 1

Where did that pay table come from? Checking out Mike's wizardofodds.com website, we find:

Dragon Bonus House Edge

NUMBER OF DECKS	PLAYER HOUSE EDGE	BANKER HOUSE EDGE
4	2.70%	9.42%
6	2.67%	9.39%
8	2.65%	9.37%

What's going on here?

That House Edge is really low for a side bet on one side, and really high on the other side. The reason for this is the asymmetry in the drawing rules – the Banker has some idea of what the

Player has because of seeing the 3rd card, and chooses whether to draw based on maximizing the chance of winning: not winning by a lot, just winning. This means the Banker will win more often by a little and less often by a lot, because the Banker will stick with a lower hand if the player didn't draw a good card. It also means the Pay Table is RIGID – Mike had to come up with something that wasn't crazily high or low on either side and there isn't much choice. (He suggested using two separate pay tables but the inventor nixed that idea.) But the House doesn't make much money on the Player side and the bettors don't appreciate the cost of going for a big win on the Banker side.

Hey, our game is more symmetrical! What happens if we apply our drawing rules?

Answer: Player 5.22%, Banker 5.50%. Much better!

But why copy a pay table that was a compromise? Maybe we can start paying at “win by 3” instead of “win by 4” if we lower the other pays a bit?

Here's what my math says:

BigWinBonus	Their bet	My bet
9	30	30
8	10	10
7	6	5
6	4	3
5	2	1
4	1	1
3	-1	1
2	-1	-1
Nat Win	1	1
Nat Tie	0	-1
Nat Loss	-1	-1
Win by 1	-1	-1
Tie	-1	-1
Loss	-1	-1
Player 8d	5.22%	5.263%
Banker 8d	5.50%	5.719%

This is cool. The changes are balanced and we are in the middle, which gives casinos flexibility. If they want a richer pay table, pay 35 to 1 on a 9-0 win and the House Edge drops to 3.4845/4.066%. Pay only 25 to 1 and it rises to 7.043%/7.371%. And so on!

Best of all, it looks better to the players. They see the same stuff at the top but suddenly winning by 3 also wins. No one is going to get upset that a Natural Tie no longer pushes, that isn't any kind of a win anyway and was just added to get the payouts for the original bet in an acceptable range. And now Banker wagerers can go for a big payout without feeling like they got a bad deal.

There are lots of other Baccarat side bets in various casinos, but there is one it makes the most sense to add in here: the “Égalité 7” bet. This pays 45 to 1 on a 7-7 tie. There are similar “Égalité” bets on other ties, but 7-7 occurs most commonly and has the lowest odds, and matches

the special no-Commission rule in the same way the “Dragon 7” side bet (not to be confused with the “Dragon Bonus” bet above), which pays 40 to 1 when the Banker wins with a 3-card 7, matches the no-Commission rule in EZ Baccarat and is used there to allow players to speculate or hedge. Again, the comparison favors our game, because 45 is bigger than 40! This also tells savvy players very clearly what they may have already suspected, that the “negative event” occurs less often here than in EZ Baccarat.

The actual probability of a 7-7 tie with our drawing rules is 1.997% as we have seen, so a 45 to 1 payout gives a House Edge of 8.130%. (The “Dragon 7” bet has a House Edge of 7.611%.)

BUT WAIT, THERE’S MORE!

We’ve got enough bets, and they lay out nicely on the tabletop as you have seen. But the rule change seems to have unlocked a lot of flexibility. Can we take advantage of it to make the game flow better?

The obvious thing to do is speed the game up – the dealer knows after seeing the first 4 cards whether the Banker will get a 3rd card, so he can deal both third cards at once.

Or, instead of speeding things up, he can deal them in the opposite order.

You might think it’s silly to want to do that, but that would tell me you haven’t seen higher stakes Baccarat games. Those games are profitable enough, despite the small House Edge, that the biggest bettor is allowed to handle the cards, and handle them roughly too! The decks in each shoe only get used once, but that’s a relatively small expense. Big players love to “peek”, curling up the edge of their card juuust enough to see what the number is, creating suspense for themselves. (Maybe the dealer should cue a drumroll....)

If they’re playing the Banker side, this is great: Life or Death! But if they’re playing the Player side, less fun—they may be happy to get an 8, but then the Dealer might pull a 9. The “big reveal” fizzles out.

But not any more. Now, if the “whale” wants to be Player and says “I want to go last”, it’s no longer a rulebook violation to give him what he wants!

In fact, we can give him even more options. The original math was very balanced when the Player hand started with 5—why not give the Big Guy free will? The dealer can still follow the “do the opposite on dealer 5” rule and the House Edge for the Player bet is almost exactly the same: 0.764% instead of 0.774%.

Well, I’ll tell you why. It screws up the side bets, and changes the House Edge for the Banker and Tie bets too. Only if everyone in the Big Guy’s crew is following him and no one else is making any bets does this make sense. Too bad.

Unless...what if EVERYONE could do it?

THE FINAL TWIST

Here is where the real magic happens.

Why can't we give everyone their own cards? Anyone who isn't making any side bets and takes the Player side can have his own "Player Bet" cards, and it won't affect anyone else because the regular common Player Hand is still there for the dealer to maintain, and people who bet Player but don't want their own cards can still use it. (If someone is really fussy about it and insists that the extra cards will screw up his own bet, just deal the potential common Player and Banker 3rd cards face down before anyone else gets any cards, and use them if needed.)

People have tried to "Blackjackify" Baccarat before, but it never worked, they always had to change the rules to make it dealable (and also to increase the House Edge enough that regular Baccarat players would sneer at the pathetic imitator).

Now, we can do it. The dealer plays the Banker hand against each of the player hands, which can be dealt face up, and the only difficulty comes when he starts with a 5, because he might have to use 2 cards against some players and 3 against others.

But that isn't so bad! After the players have taken their 3rd cards, the dealer turns up the common Player hand and the Banker hand. If the Banker hand is 0-4 he draws, 6-9 he stands, and he settles everything (remembering that his 3-card hand will lose to any player Natural even if it is 8 or 9). If he has 5, he FIRST settles against the Player hands which took a 3rd card, and THEN takes his 3rd cards and settles against the Player hands which stood pat!

BUT WILL THEY GO FOR IT?

It's impressive how much we could change and improve the game. But just because I say it's an improvement doesn't mean bettors will agree. This game needs to be rolled out in a way that makes its advantages so apparent that after playing it for a while, people won't want to go back to Standard Baccarat.

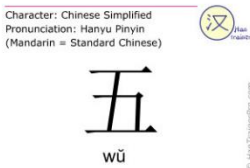
For every single bet on the table, there's an argument that it's better. And the game flow can be seen as better too. And the simplicity means that NEW players who thought Baccarat was weird will try it. And dealers can be trained much faster and don't have to remember the complicated 3rd card rule and always get it right.

But what can we call it?

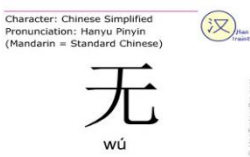
The name "Louisiana Baccarat" was suggested by Eliot Jacobson, and I could make up a story about how in New Orleans casinos back in the old days those Cajuns found the fancy Monte Carlo rules too complicated and slow and came up with their own, but really it's just something that sounds good and is memorable and has a very sneaky phonetic trick going on which I'll let you figure out for yourselves.

Everyone asks about the Asian Market. Will they go for it? I've given the tabletop a Far Eastern look, but more creativity may be needed.

Well, Asian gamblers love numerology, and in Chinese, here are a couple of characters:



This means “five”.



This means “none”—same syllable, different tone.

Maybe someone can come up with a name that plays on the special “don’t copy five” rule....

IN CONCLUSION

The biggest new game in this century was also the winner of the very first Cutting Edge Table Games competition in 2009: EZ Baccarat. Robin Powell and Francisco “TJ” Tejada dared to reimagine Baccarat with their No-Commission idea, and history was made.

I won’t say I have a *better* Baccarat idea than they did, but I definitely have *more* of them....

Can lightning strike twice here? Make it so.