

RECORD, Volume 26, No. 1*

Las Vegas Spring Meeting
May 22–24, 2000

Session 93TS The Wizard of Odds!

Track: Actuary of the Future

Instructor: Michael W. Shackelford

Summary: This session features a presentation by a nontraditional actuary who offers a mathematical look at gambling. The speaker discusses his experience with actuarial consulting pertaining to the study of old and new forms of casino gambling. Learn the rules, the odds, and the correct strategy for casino games. The "Wizard of Odds" also discusses his experiences as a regular columnist for Casino Player magazine and as a featured columnist on the Detroit News Web Page.

Mr. Michael W. Shackelford: I would like to give you a little bit of background about myself. I started my actuarial career with the Social Security Administration where I worked for almost ten years. What I did there was short-range actuarial estimates on Congressional legislation affecting Social Security. In the early part of my actuarial career, I worked hard at the exams, I must say, I really enjoyed them. I found every problem a challenge, and I actually missed the exams once I finished in 1995. To put my mind to something else, I started to evaluate some of the casino games just for the fun of it. I started out with some of the easy ones like craps, keno, and let it ride. At the same time, I discovered the Internet and used my Web site as a clearing house for math problems and casino game analysis. I later named my gambling Web site The Wizard of Odds and devoted much of my time to adding new material and improving what was already there.

People both in and out of the gambling business began to approach me via e-mail, asking me to evaluate their games, which they hoped to introduce to the casino market. Gradually, consulting work became more frequent. In the early part of this year, I started accepting advertising. Between these two forms of income, I was finally in a financial position to leave my day job and devote myself full time to evaluating new games and the upkeep of my Web site.

Before a game can be approved for casino use, it has to be professionally evaluated. The gaming authorities in Las Vegas also will review the game before approving it. The approaches I use to analyze games depend upon the game. I might use a random simulation for games like blackjack or Pai Gow poker. I might use a combination approach for games like video poker. Sometimes I use just pure math for easier games like craps or roulette.

If any of you are thinking of getting into the business of game analysis, let me give you some advice. Always get the exact rules of the game you're analyzing from the client. Oftentimes, I don't deal with the person who invented the game but someone in-between, and I get very vague second hand rules. If I ask specific questions about the rules, the answer will usually be, "Just interpret what I gave you as best you can." This often leads to a misunderstanding of the rules, which necessitates going back to the beginning.

I also stipulate that if rule changes are going to be suggested, then I reserve the right to charge extra. Analyzing games with wild cards can be very difficult, and I always charge accordingly.

I also advise clients on the marketability of their games. Many games will never make it because they are too complicated or could be defeated by card counters or hidden partnerships between players. If a game does become successful, it might be vulnerable to lawsuits from other parties who claim that you stole their game idea.

I'd like to begin my gambling advice with my ten commandments of gambling. I'm going to go over these quickly because I don't want to insult your intelligence. This is obviously a very mathematically gifted audience.

Commandment number one: Be realistic. The casinos have the odds in their favor. If you lose, expect it. You might think this sounds obvious, but you'd be surprised by how many people think they have some secret method to beat the casinos. If they are losing, they will keep betting more to chase after their losses. Don't do that. Gambling should be thought of as entertainment. If you lose, that's the price you pay for your entertainment.

Commandment number two: Don't rely on hunches. Always make the best mathematical decision. I know a lot of people will never agree with me on this one and that's fine. Some people don't want to lose their free will, and they're willing to lose more money for it. However, if you want the best long-term results, always go with the math.

Commandment number three: Although you will lose over the long run, in the short run, your money will go up and down like a roller coaster. This is especially important for people who are professional gamblers, like card counters or poker players. For example, in blackjack, even the best card counters will probably only have about a 1% edge. In the short run, even with that 1% edge, your money can go down fast and for a long time. An entire month can be at a loss. You have to have faith in the math and that you will see a profit over the long haul, but it can take a long time to get into the long haul.

Commandment number four: In general, the harder a game is to understand, the smaller the house edge is if you play it correctly. Take craps for example. It looks really complicated, but once you know how to play it correctly and what the best

bets are, you can enjoy a very low house edge. The games that are really easy to understand like slots and keno are among the worst bets.

Commandment number five: Don't bet money that you can't afford to lose. Set a limit on your losses for both a sitting and the duration of your trip.

Commandment number six: Don't hedge your bets. A good example of a hedge bet is the insurance bet in blackjack, which is a very bad bet. It carries a house edge of about 7%. Another game where people often hedge their bets is craps where people will bet on any craps or any seven to ensure that their line bets win. Don't do it. Those bets have house edges as high as 17%. Another reason you shouldn't hedge your bets is because you're in the casino gamble.

Commandment number seven: There is no system that can beat a game of pure chance. I know that as long as I'm in this business, I will continue to debate people on this. Every single day it seems like somebody is sending me an e-mail asking, "What do you think of this betting system? I don't believe what you said on your Web site about betting systems. I have this system, and I win with it."

Trust me. Most betting systems are designed to have a lot of small wins in exchange for a few big losses. People often have false confidence in betting systems when they're riding these small wins, but eventually the law of averages will catch up to them and they'll lose everything that they won and more.

Commandment number eight: It pays to shop around for the best playing conditions. This is especially true in video poker and blackjack where the rules can vary from one place to another. If you're just playing for fun, it might not be worth the time to go way across town for an extra quarter of a percent. If you're a serious gambler, it's good to know where the best video poker games or blackjack games are located.

Commandment number nine: Avoid the side bets and gimmicks. I have never seen an exception to this one. In a lot of the games like blackjack, Pai Gow poker, Caribbean stud, and let it ride, there will often be some bet where you can have a chance at a big payoff if you get a royal flush or some very unlikely cards. The risk is never worth the reward with a house edge as high as 30% or more.

Commandment number ten: Have fun. Unless you are a professional gambler, the motive for gambling should be for entertainment. If you have to win to enjoy playing, then don't play at all.

That being said, let me talk about some of the specific games in alphabetical order.

Baccarat. This is a very easy game to play. There are only three bets: the banker, the player, and a tie. Cards are dealt according to set rules to both a player and a banker hand. The only choice is betting on whether the banker or player will have the greater total or a tie. There's no skill involved, and the best bet is on the banker with a house edge of 1.064%. Comparatively speaking, this is a good bet.

The house edge on the player is 1.228%, and the house edge on the tie bet is over 7%. It's a bad bet.

Many baccarat players will keep track of all past outcomes looking for patterns. It's a waste of time. The best bet is always on the banker unless you're card counting, but card counting in Baccarat is not worth the effort.

Blackjack is my favorite game. It is what I play 95% of the time, You can ask any pit boss for a gaming guide. Blackjack is one of those games where the rules can vary from one place to another, so if you're going to be playing for big money or you're really serious about the game, look for good rules. In general, the fewer the number of decks, the better. It is better if the dealer stands on a soft 17. It is better if the player can double after splitting. It is also to the advantage of the player if surrender or resplitting aces are allowed. The typical house edge in a Las Vegas single deck game is 0.18% and for a typical six deck shoe game it is 0.40%.

From the Floor: Can you comment on shuffling machines? Do they offer a fair shuffle?

Mr. Shackelford: Automatic shufflers are basically a timesaving device so that the dealers don't have to shuffle after every hand. With a shuffling machine two decks are used, while they're playing one deck, the machine is shuffling the other, so that when they're done, they just reach for the new deck and can immediately start playing. I have a lot of faith that they are good and provide a good random shuffle.

From the Floor: Can you comment on the kind of shuffling machines that immediately put discards back in the deck?

Mr. Shackelford: These machines work by taking the discards and putting them back in the shoe. Again that's a time-saving device where, in a hand of blackjack, they will take the last cards that were just dealt, and somehow they get randomly inserted back into the deck. It is essentially like playing with a fresh shuffled deck every time, so it would be a waste of time to count cards against one of them.

From the Floor: Just a point of reference. The cover of a 1995 issue of *Blackjack Players Forum* said the shuffle monster is coming and Arnold Snyder, who is probably the best authority on blackjack, talked about it. He predicted that, by the year 2000, blackjack would be doomed and that almost all the games would be automatic shuffling machines. But the players don't like them, including most of the players that aren't card counters, but it never really has caught on.

Mr. Shackelford: Thanks for that remark. His prediction has turned out not to be true. You do see them at some places. But I have the sense that players don't like too much of a mechanical game. They like to see the dealer shuffling the cards, so the vast majority of games are still hand shuffled.

Next is what's called the basic strategy. This is how to play any hand in blackjack, assuming you're not counting cards, according to the best possible odds. There's a

different strategy for single deck as opposed to multiple deck. The table is somewhat self-explanatory. The key is at the bottom. Depending on what you have, you may either double, split, hit or stand. Your hand goes along vertically and the dealer's up card is horizontal. In some situations what you do depends on the exact rules. For example, in single deck, if you have a Web siter of twos and the dealer has a two, you would split if you're allowed to double after a split; otherwise, you'd hit. If you know and play the strategy, depending upon the rules, you can have the low house edges that I just spoke of. Even in an eight-deck game, your house edge is going to be about 0.43%. So it's almost like playing for free. Some casinos sell these charts in the gift stores, but I should caution you that sometimes the charts are wrong. The one I saw in the Rio was correct, and they will allow you to play with these at the table. So if you ever want to have a low house edge in the casino, blackjack with the basic strategy is the way to go. If you want to memorize the basic strategy, I would encourage you to make flash cards. If you deal hands to yourself, you're not going to get some of the rare situations like the splits often enough to test your memory on. Once you master the basic strategy, you can always proceed with card counting, and it's basically unlimited as to how much improvement you can make.

From the Floor: Why is the basic strategy different for one deck and eight decks? If you aren't card counting, what difference does it make?

Mr. Shackelford: The reason is that in single deck, once one card leaves the deck, that has an important impact on the distribution of the rest of the cards. In an eight-deck game, for example, once one card leaves, it almost has no significance because there are so many other cards left. That's why it's different. In a single deck, sometimes there's what's called the composition-dependent basic strategy, with which I didn't want to confuse the issue. Sometimes, based on the exact composition of the cards, you might deviate from the basic strategy. For example, with a 13 against a 2 you should stand. However, if your 13 is composed of a 10 and a 3, you should hit it. But if you memorize all these exceptions, it doesn't benefit you very much. For most people, it's not worth the bother.

From the Floor: Why does your strategy indicate to stand on two 9's against a 7?

Mr. Shackelford: Because you already have an 18, and that will beat a dealer's 17. I have a combinatorial program that shows that by standing the player's expected return is greater than splitting. Any respectable blackjack author will tell you the same thing. You can go to any bookstore and look at any blackjack book written by anybody except John Patrick, and I'm sure it will tell you to stand on two nines against a seven.

From the Floor: Why do you advise splitting two 9's against a 9?

Mr. Shackelford: If you stand, you have an 18, but what if the dealer has a 10 under there and gets a nineteen. You lose. Now if you split, you have a chance of getting some 19s and at least pushing against the dealer. There's no easy rule of thumb to explain why a play is the best. You have to analyze everything that can

happen and the probability of it happening. Add it all together to see what the best play is. My program shows and any respectable source will tell you that if you have two nines against a nine, you should split.

From the Floor: What is double exposure?

Mr. Shackelford: Double exposure is a blackjack variation where you get to see both the dealer's cards, but the dealer wins on pushes; blackjack only pays even money, and I think there's some other disincentives as well. If you play optimal strategy against double exposure, your house edge is not as high as it is in regular blackjack. Therefore, I wouldn't recommend bothering with that game. It's hard to find anyway. In fact, I don't know of any place that has it at the moment.

From the Floor: Do most casinos let the player surrender?

Mr. Shackelford: You can never count on any place offering surrender. Most places don't but some of them do.

From the Floor: A comment and then a question. My comment is, why is the single deck basic strategy different from that of eight-deck. The hand that probably best exemplifies it is a Web siter of sevens against a ten. Normally in two deck, six deck, and eight deck, I'm hitting without even thinking about it. But it makes sense in single deck because my probability of getting to 21 has now been halved. I've eliminated two of the sevens. That's my best card. I'm suddenly thinking of surrendering because of that, so I like using that hand as an example.

It seems like you always run into someone that talks about how they're a card counter, professional card player and the like, and they have these charts where it's rule contingent as to what you should do. For instance, if you have a Web siter of twos and the dealer has a two up, you need to know what the rules in the casino are to play optimally. When I've asked people how to play a Web siter of twos against a two, no one has ever given me the correct answer, which is, I need to know what the rules are. But any good player would be able to go ahead and provide that answer.

If you live in Las Vegas, you're playing at a slight disadvantage, even without counting. The casino is going to go ahead and refund you about 0.8% of the expected total play in comp credits. You'll get your rooms, meals, and so on complimentary. Are you aware of any professionals that are just playing for comps and then selling them? I certainly see that as viable.

Mr. Shackelford: You raised some good points there. The first one is absolutely right. One good example of a difference between the single deck basic strategy and the multiple deck is you have two sevens and the dealer has a ten; in single deck you should stand. That's because there are already two sevens removed from the deck and your odds of getting a third seven to beat a 20 are drastically reduced.

You also raised a good point about comps. You can always apply for a player's card at any casino. If you play anything, slots or the table games, they'll evaluate your play based on how long you play and how much you bet. A good rule of thumb is that they will take the product of the amount of action you have bet and the house edge and give you about one-fourth to one-third back as comps. I believe they figure the house edge in blackjack to be about 3%.

However, if you're playing basic strategy, you are only bucking about a 0.4% edge, so with the comps you're actually coming out ahead. Many people are much more aggressive about this in video poker. They might be playing a game that's slightly suboptimal, but with the cash back they get from video poker, they can actually make a little money. However, video poker has dried up lately and with the cash back, it might only come out a little bit ahead.

You mentioned something about playing for comps seriously, maybe even as a living. I've never heard of anyone doing that professionally, but a lot of people are very aggressive about getting as much in comps as they can. There's one lady, I forget her name, who boasts that she stays in casinos half the year and has never Web sited for a meal or a hotel room and doesn't gamble huge amounts either. She just knows where to get the most bang for her buck and knows how to milk the comping system. Someone could talk all day about that, but that's not my area of expertise.

From the Floor: Just in general, how would the basic strategy change if you were counting to plus one for ten, minus one for two to five?

Mr. Shackelford: A good play that is count-intensive is if you have a 16 against the 10. That's a very borderline play. If there's just a slight surplus of big cards in the deck, then you should stand. Another very card count-intensive play is a 12 against a 3 or a 4. Don Schlesinger once came out with a list called the illustrious 18. It is the 18 most important hands to remember that are count-intensive and to sometimes change how you would play depending on the count.

From the Floor: How should the player play an 8 and a 9?

Mr. Shackelford: If you had an eight and a nine, that would be a 17 and you always stand. If you have a hard 17 or more, then always stand. If you have a hard 7 or less, then always hit.

From the Floor: Can bad players predestine the entire table to lose?

Mr. Shackelford: The answer is an emphatic no. One of the biggest myths about gambling is that stupid players will somehow mystically disrupt the order of the cards and cause everyone else to lose. That is just patently untrue. It is often expected of the last player to be very conservative about hitting and splitting. The theory is that somehow the cards are set up to bust the dealer by the time it is the last player's turn. So I will avoid the last-place position, if I can, just to avoid other players giving me bad looks. I was playing Spanish 21 in the last position because

it was the only one open, and I was playing according to the basic strategy, which I created for Spanish 21, which is a lot different from regular blackjack. The other players were playing regular blackjack strategy in Spanish 21, which is highly ill-advised due the removal of the tens from the deck. Spanish 21 calls for much more hitting which is what upset the other players.

From the Floor: What is the house edge in Spanish 21?

Mr. Shackelford: If the dealer hits a soft 17 the house edge is 0.69%. If the dealer stands on a soft 17 the house edge is 0.34%. A Spanish 21 basic strategy can be found on my Web site.

From the Floor: Do you keep track of your wins and losses?

Mr. Shackelford: Last year, I came to Vegas twice and both times I was aggressively counting cards, and I did keep track of my win or loss at every single session. I believe I won about 1,500 last year and that's betting moderately. My betting range was about \$10–50. This time I haven't been card counting at all. Since I'm just playing for fun, I haven't bothered keeping track of my wins and losses. When I gamble online I am very religious about keeping records in the event there is a dispute, as is often the case.

From the Floor: Can a player earn comps at online casinos?

Mr. Shackelford: Some online casinos are very generous about promotions. A typical one might be that they will give you 20% of a deposit, and you're required to bet the sum of the deposit and the bonus. This can be a very attractive deal. For example, if you deposit \$1,000 for a \$200 bonus and bet \$3,000 against a 0.5% house edge, you are only giving up an expected \$15. This is a small price to pay for a \$200 bonus.

From the Floor: Has anyone figured out the way the random number generator worked at an online casino?

Mr. Shackelford: I have heard that somebody figured out the way the numbers were coming up in keno. Once he figured it out he took this online casino for a very large sum of money. Once you know what numbers will come up, you can't help but win.

From the Floor: Have you ever been caught card counting, and if so, how did you handle it, and how do you keep from getting caught?

Mr. Shackelford: That's a good question. Yes, I have been caught card counting twice, both times last year. The first time was at the Horseshoe downtown and the pit boss said something to the effect that the boss doesn't want your action anymore. You can play anything else, but you're never allowed to play blackjack here again. Later that same trip I was playing at the El Cortez, which is a very easy place to get kicked out of, and even though I was losing a lot of money there,

the pit boss kicked me out there and was quite rude about too. To avoid being detected, you have to employ what's called camouflage, in other words don't look like you're counting cards. The best way to do that is to never be too greedy about increasing your bets when the count is good. For example, a good rule of thumb is never more than double your bet. It's good if you're able to be social with the other players to make it look like you're not focusing on the game as carefully as I have a habit of doing. There's a host of other things you can do. For example, never play more than say 45 minutes, or they get too suspicious. You can always come back on a later shift to the same place.

Entire books have been written about this, Ian Anderson has a good one called *Turning the Tables on Las Vegas*. He talks a lot about avoiding detection. Some people can get quite elaborate by playing in teams where they will have one card counter who's just sitting there quietly flat bedding, giving signals to what's called a big player as to how the count is and how to play his hand in borderline situations. The big player can be sitting there drinking and being obnoxious and no one would ever suspect him or her of being a good player. This is similar to what happened in the movie *Rain Man*.

From the Floor: In case anyone here really hasn't played cards or doesn't know much about it, card counting is not cheating. You may see it directly said or implied in the media. There's a recent article in *Investors Business Daily* that pretty much came out and said that card counting is not illegal. Card counting is not illegal, it is not cheating, and so when you are thrown out for counting cards, it's just basically a matter of a property owner exerting his or her right to serve whomever he or she wants.

Mr. Shackelford: You're absolutely right. Some people incorrectly think that it's illegal to count cards, including some police officers. The players have the legal right to count, and the casinos have the legal right to ask you to leave. I think it is actually best this way.

If a player is caught counting they will usually issue a warning the first time and ask you to not return. The second time they may read the "trespass act," which is an official warning to not return. The third time they will have you arrested for trespassing.

From the Floor: Can the casinos do anything else to protect themselves against card counters in addition to barring them?

Mr. Shackelford: A common defense is the dealer will shuffle the cards if they see you raise your bets. When some people notice the dealer is doing that, they will raise their bet when the count is bad to make the dealer shuffle the cards. That way, they are always playing in either a neutral or positive deck.

From the Floor: Another strategy is to start with a large bet and lower it if the count becomes negative. For example they may start with \$300, and if the count goes negative, then they'll go down to \$100 and avoid suspicion that way. When

you look at the probability distributions, they have a positive game because it's playing more of their action in the favorable counts than the negative counts.

Mr. Shackelford: That's another strategy that some people employ.

Let me give you some advice on some of the other games.

Caribbean Stud Poker. This is not a very good game, but let me give you some advice on how to play it. In this game, you get five cards and if you like your hand, you can triple your bet. If you don't like it, you can just forfeit everything and you lose. The correct strategy in this game is if you have any Web site or better you should raise. If you do not have at least an ace and king, you should fold. However, if you have an ace and a king, then it gets into a gray area and three rules of thumb that will get you very, very close to playing optimally.

The three rules of thumb are:

- (1) If you have an ace and a king and the dealer's card is a two through a queen and matches one of yours, then you should raise.
- (2) If the dealer's card is a king or an ace, then you should raise if you also have a jack and a queen in your hand.
- (3) If the dealer's card does not match one of yours then you should have a queen in your hand, and your fourth highest card should beat the dealer's up card for you to raise on an ace and a king.

Following optimal strategy, the house edge in Caribbean Stud Poker is 5.224%, which is not a very good bet.

Craps has a host of different betting options. Some of them are very good bets, and some of them are terrible bets. The best bets are the simple line bets like the pass, don't pass, come and don't come. Craps is the only game in the casinos that offers a bet with no house edge called the odds. However, this bet cannot be made by itself; it has to be made in conjunction with a pass, don't pass, come, or don't come bet. If you combine any line bet with the odds, depending on how much money you can put on the odds, you can get your house edge down to half a percent or less. If you ever see on a marquis something like 5x odds on craps, that means that you can bet five times on the odds whatever your line bet was. By the way, the don't pass is better than the pass; however, the vast majority of people will bet on the pass bet and the difference is small. Sometimes I will bet on the pass as opposed to the don't pass, just because that's what everyone else is betting on, and it's more fun to cheer when everyone else is cheering. I admit this is a violation of my own commandment, but the difference is small and the objective of gambling should be to have fun.

From the Floor: What are full double odds?

Mr. Shackelford: Full double odds allow you to bet 2.5 times your line bet if the point is a six or an eight. The reason they let you do that is if you bet \$2.00 on the pass line and roll a six, then the odds would pay six to five. So, if they only allow

double odds, that would mean that you could bet \$4.00 on the six, which would pay \$4.80 if you won. The casinos don't want to mess with 80 cents, so that's why they let you bet \$5.00, which would pay an even \$6.00.

From the Floor: What is your opinion of the strategy of betting on the pass line and making two or three come bets?

Mr. Shackelford: Many people employ various strategies in craps. I don't really have time to get into the intricacies of craps, but the come bet is basically like a pass line bet, but it can be made at any time except on the come out roll. Some people like to have one pass line bet and two or three come bets going at once. Over the long haul, it doesn't really matter how you mix up your pass and come bets; the house edge is always going to be the same.

Let It Ride. This is another kind of new game. In Let It Ride, you start by placing three bets and you get three cards. At this point, you can either let it ride, which is basically do nothing, or you can take back one of your bets if you don't like your cards. Then the dealer will deal a fourth card and you have the same decision again, pull back a bet or let it ride. Then the fifth card is dealt, and you are Web sited based on the five remaining cards. At least a Web siter of tens is required to win anything. The house edge in let it ride is about 3.5%, which is pretty high, so I wouldn't suggest you play Let it Ride.

From the Floor: Can the player improve the odds in Let it Ride by looking at other player's cards?

Mr. Shackelford: The answer is yes. For example, if you had say a Web siter of fives and you noticed two other fives were already gone, that's going to lower odds of getting a three of a kind. However, if you're that serious about the mathematics of the game, you shouldn't be bothering with Let It Ride at all. You should play something like blackjack or video poker where you truly do have good odds. In Caribbean Stud, Professor John M. Gwynn Jr. and Peter Griffin figured out that if you had perfect knowledge of all the other players' cards in a seven player game, and you had all the computing power of a computer in your brain, you could beat the game. However, in real life, nobody is going to be able to see every other card and compute all the odds in their head, so it's just an academic point. In blackjack, it's often good to steal glances at other players in borderline situations. That's why, in single deck games, dealers usually deal face down so you can't see the other players' cards.

Video poker. There are all kinds of video poker variations out there, and it's a complicated game to analyze. There's not an easy rule of thumb regarding how to play any situation. What I did was evaluate 49 kinds of initial hands. You can look up whatever you have, and it will tell you your expected return based on playing your cards any viable way. For example let's say you have four to a flush, but a low Web siter. Look up your expected return for the four to a flush and a low Web siter. Whichever one is higher on the list is the better way to play the hand. In that particular situation, going for the flush is the better play. This is based on just

regular jacks are better. There are no wild cards and no fancy stuff. Assuming that it's full pay, it means a flush pays six and a full house pays nine. There are other video poker strategies on the market that are more abbreviated, but they give you slightly less return than playing optimal strategy.

From the Floor: What is the proper strategy for three-card poker?

Mr. Shackelford: The best bet in three-card poker is ante and raise. The optimal strategy is to raise with a queen, a six, and a four or better. The house edge, assuming you employ that strategy, is just a hair over 2%, which isn't too bad. Three-card poker is not a very popular game.

From the Floor: What is the house edge in Pai Gow poker?

Mr. Shackelford: The house edge in Pai Gow poker depends upon whether you're banking or not. When you are banking and you play by the house way, you're essentially playing with no house edge. However, when you're not banking, the house edge is about 2.9%. Assuming that you're banking half the action and not banking half the action, the house edge comes to about 1.4%. Pai Gow poker, by the way, is a really good game to play if you just want your money to last a long time. The house edge is not too bad. The game is very slow-paced, so you can sit there and play for hours and hours with a moderate buy-in.

From the Floor: What was the reason for including this talk in the syllabus?

Mr. Shackelford: I think the point of this is to show other ways to use actuarial skills in the marketplace.

From the Floor: How are the rules different between Las Vegas and Atlantic City?

Mr. Shackelford: In general the rules are much better in Las Vegas. For example, in blackjack you see single-deck and double-deck games in Las Vegas. In Atlantic City, almost all the blackjack tables use an eight deck. The video poker is better here. The slots pay better.

Let me talk a little bit about slots and how they work. The machine is constantly drawing random numbers, and at the moment you spin the reels, it will take whatever random numbers were chosen at that instant and divide them by a certain number. Take the remainder and that will determine where the reels stop. The positions on the reels are not weighted with equal probability. In general, the nonpaying symbols like the blanks are much more likely to come up than the paying symbols. In general, the first reel is weighted most generously, and more than the second and the third. That's why you often see it where you get a seven and then another seven and then nothing. That's because the last reel is usually rather tight. The slot manufacturers can weight the reels however they want, depending upon how the casino wants the game to pay out.

Let me address some of the myths about slot machines. First of all, slot machines are random. You hear a lot of people complaining about machines being in a tight part of a cycle. There are not tight phases and generous phases. Every spin is equally random. You're just as likely to get the jackpot on any give spin, regardless of how long it has been since the last one. There is an exception with the fruit machines in London, but U.S. machines are all perfectly random. Some people incorrectly think that with a flip of a switch, the casino can make all the machines tight, but they cannot do that. To change the pay out of a machine, they have to seek the permission of the gaming authorities and replace the e-prom in the machine to change the pay out.

From the Floor: Can you recommend any good Texas Hold 'Em software?

Mr. Shackelford: Everything I've ever seen has been pretty bad, but I've only played simple ones like in Hoyles. It doesn't take long before you figure out the betting habits of your computer opponents.

From the Floor: Where are the best blackjack games in Las Vegas for the card counter?

Mr. Shackelford: That can vary from one month to another. What is important is how deeply into the deck they deal. This penetration factor can change frequently so the list of the best games is also changing frequently. Normally, the best rules are used at downtown casinos, but there are some good card counting opportunities up and down the strip.

From the Floor: What is the house edge on slot machines?

Mr. Shackelford: If you go to my web site, I indicate who has the best paybacks on a region-by-region basis and casino by casino. The actual return is reported for various different denominations, but for the state of Nevada, Las Vegas is lumped into Clark County. In general, the good slot machines can be found downtown and in places where the locals play, like the Sunset Station and Sam's Town. One machine can pay differently than an identical machine right next to it. It all depends on the e-prom inside the machine. If you are playing on a tight machine, it wouldn't be a bad idea to move to another one.

From the Floor: Where do the casinos put their highest paying slots?

Mr. Shackelford: The casinos will put their best-paying machines in highly visible areas. They want the other players to see people winning, so they're unlikely to put a generous machine way back in the corner.

From the Floor: Do any machines pay more than a 100%?

Mr. Shackelford: Some machines have a progressive jackpot, and if the jackpot gets high enough, you can have over a 100% return. However it's hard to really know when you have the advantage because the casinos, unlike with the table

games, are not going to reveal to you what the payback percentages are. They won't tell you how their reels are weighted. Driving from LA to Vegas, I've seen marquis that say, "Our machines pay up to 100.1%." What that means is they may have one machine that pays back 100.1%, but all the rest pay back much less.

Do you think, regarding the positive expectation, that there are people who make a living doing these things? Some of my friends drag me out to Mahoney's Silver something Casino. It's up north. They have a coupon because they subscribe to this local publication, *The Las Vegas Adviser*. It gives you a 125-coin bonus if you hit four of a kind. That was fun because I've never played video poker before, and there's software that you can practice on. It's amazing how many mistakes you can make initially. We all went up and we played until we hit our four of kind. We got a 125 to 1 bonus, which is basically a free \$125. If you played \$5 machines, it would have been a free \$400, which was the cap. So the expectation was a free \$300 for playing for an hour. Although you are advised to watch out for gimmicks, I want to point this out as an example of a good gimmick. It is the same thing with the online casinos. I've heard some people are making a good \$2,000 or \$3,000 dollars a month, just with sign-on fees and 10% and 20% bonuses and being very successful with that. I haven't been doing it, but I hear that that's really effective. I wanted to go back to the other question as far as what a card counter looks for. You're absolutely right, but the rules are important. When you're playing, you really want to try to get a heads-up game along with that penetration because how many people have billable hours? The same thing applies to a card counter. If he plays at a full table and only gets 50 hands an hour, or if he plays one on one, he can get up to 150 hands an hour. So he can basically fill three times as much in the long run, and he can make three times as much betting the same amount.

As for a card counter, the amount you can expect to make is directly related to how many other players are at the table. The fewer the better because that's all the more hands you'll see per hour. When I said avoid the side bets and gimmicks, I was referring to specific bets. There are also good gimmicks. For example at the Rio, where I'm staying, I believe they will refund half your losses on your first hour of slot play. If you want to take advantage of those kinds of promotions, then do so. You also mentioned online casinos. Up until recently, I was making the kind of figures that you based on the bonuses alone.

From the Floor: What is your opinion about tipping the dealers?

Mr. Shackelford: This issue is often debated among card counters and my opinion is you should toke the dealer for the same reason you would leave a tip in a restaurant. It's just the polite and decent thing to do. The dealers only make about six dollars an hour, so I think that they deserve the tips. Yes, it does eat into your return, but just for humanitarian reasons, you should tip anyway. There are more important things than money.

How much should you tip the dealer? I think if you're betting small that \$3 an hour is sufficient. How much should you tip exactly? Everyone will say something

different. Just don't be tight. You should tip the dealer, and you should also tip the cocktail waitresses.

From the Floor: How are online casinos regulated?

Mr. Shackelford: Online gambling is almost totally unregulated. In most casinos, you can buy your license, and that gives you license to do whatever you want to. Online casinos based in Antigua seem to be the most reputable and regulated. It also is a good sign if a casino uses software from a reputable company like Microgaming or Boss Media. However, this is still not a guarantee of fairness. There is a big controversy involving the Golden Palace, one of the biggest online casinos. They seized some player accounts for violating an "implied contract" and "bonus abuse." The authorities have conveniently ruled in the favor of the casino, despite the fact that the players obeyed every rule set by the Golden Palace.

From the Floor: As a nontraditional actuary, is there any kind of accreditation you need?

Mr. Shackelford: The answer is no. I have my ASA and I just pay my dues and that's it. No one has ever asked anything of me in terms of accreditation.

From the Floor: Can a card counter contest a barring in court? Also, how much is bet in total in Las Vegas per year?

Mr. Shackelford: The casinos videotape everything in case of a barring. However, I've never really heard of this being an issue. The casinos carry a lot of credibility, and it's really difficult to fight them. If they read you the trespass act, and you go back and they have you arrested, I think you should just take your punishment. The second question was about how much is bet in the state of Nevada or Las Vegas? The answer is, I don't know.

From the Floor: What did you mean when you said video poker has dried up?

Mr. Shackelford: That means that the payoff tables on the machines have been changed to make them stingier. From what I understand, professional video players have had to move on to other things.

From the Floor: You don't distinguish between four to an inside and an outside for a straight flush or royal flush.

Mr. Shackelford: That's because it doesn't matter. If you have four to either one of those, the placement in the order is the same.

From the Floor: Can you comment on multi-line video poker? Is the house edge different than regular video poker?

Mr. Shackelford: Some video poker machines give the player an initial hand as usual. However multiple sets of replacements are made. The question is, are these

any better or worse than regular video poker. Assuming the payoff table is the same, then the long-term edge is also the same. However, it's a good way to cut down the volatility of video poker and video poker is a pretty volatile game.

From the Floor: Can you comment on match play coupons? Have you ever evaluated them?

Mr. Shackelford: I like match play coupons. Many casinos have fun books where you can make a bet on say roulette on red or black, and if you win, they will pay back double whatever you're supposed to get. If you ever get one of those, go ahead and take advantage of it. It is free money basically. The best fun book, by the way, is at the Lady Luck downtown. They have some really good deals in there. You also asked whether I have ever done any evaluation of those kinds of incentives. The answer is no, I haven't.

From the Floor: Is there any correlation between the denomination of a slot machine and its payback percentage?

Mr. Shackelford: The answer is absolutely yes. The higher the denomination, the better the payback. The payback on the nickel machines is pretty bad. It's approximately 91%, whereas on the dollars it's about 97.5%. For \$5 machines, I think it is about 98.2%. On my web site, I indicate exactly what the percentages are by region and by denomination.

From the Floor: What is the element of ruin?

Mr. Shackelford: This is something that's very important to card counters. For example, let's say a man makes a trip to Vegas with \$50,000 in an account and his objective is to double his money or to lose it all. The element of ruin is the probability of doubling the bankroll before losing all of it. A typical element of ruin will be 95% or 97%. The higher the probability, the smaller the bet size, and the longer it's going to take to achieve your goal. I think *Professional Blackjack* by Stanford Wong and *Millionaire Dollar Blackjack* by Ken Houston explain this topic in more detail.

From the Floor: Can you recommend any blackjack software?

Mr. Shackelford: There's another actuary named Hal Marcus who is also in the gambling business. He has a product called Blackjack 6, 7, 8, which is the only one that I've ever used, so I can't compare it to anything else. I rely mostly on my own programs to evaluate the game.

From the Floor: What is the reason for splitting 8's against a 10?

Mr. Shackelford: Your expected value, either way, is negative. However you're going to lose a little bit less by splitting and then by hitting. It's very marginal, but the correct play is to always split eights.

From the Floor: What if surrender is an option?

Mr. Shackelford: You should still split the 8's against a 10.

From the Floor: What computer language do you use to evaluate games?

Mr. Shackelford: C++.

From the Floor: Can you comment on sports betting?

Mr. Shackelford: On my Web site, I've recently analyzed various kinds of bets including straight bets, teasers, and proposition bets. The best bets are just the straight ones. Never bet on the propositions, teasers, or any of the exotic stuff. You're always bucking a big house edge by doing that.