Twenty-One

The casino game of Twenty-One, popularly called Blackjack (actually the home version of the game), achieved wider popularity when computers showed in the early 60s that the game could be beaten. Players flocked to Las Vegas and Reno, thinking to win scads of money, but the great majority did not have the skills and discipline needed to win. The casinos loved the extra business. The film "21," based on the book by Ben Mezrich entitled "*21: Bringing Down the House*," screen play by Peter Seinfeld and Allan Loeb, tells the story of a group of students from the Massachusetts Institute of Technology (MIT), who in 1994 formed a team of players with the initial goal of beating the game in Las Vegas casinos. The film's hero was named Ben, the book's was Kevin. This was not a new idea, as professional player Ken Uston had done the same a decade before. The MIT team merely copied his tactics, with minor variations. Before going further, let's look first at a 21 table and typical rules for its game:

Four or more half-moon shaped 21 tables are arrayed in a circle, with dealers behind each table facing the outer rounded side and its five to seven player seats. A plastic card shows the rules in effect, including minimum and maximum bets. There may be many large table groups. The tables enclose a "pit" area in which pit personnel, one of whom is the "pit boss," monitor the tables, with telephones and a computer display on hand. The dealer handles the cards, converts players' cash into chips, pays out wins and collects losses.

The game begins with a shuffle of the cards (standard decks) by the dealer and a cut by one of the players. A player bets by putting one or more chips into the circle in front of him. Playing multiple circles is allowed if one or more adjacent circles are available. The dealer gives each player two cards for a "hand," plus two for himself, the second face up on top of a face-down "hole card." The cards are ranked A, 2, 3, ...9, 10, Jack, Queen, King, with the ace having a value of either 1 or 11 (as desired during play) and face cards count as 10, so we call them 10s. The goal is to have a total as close as possible, or equal to, 21. If the total is greater than 21, the player loses ("busting"), even if the dealer busts too. Players with a low total can ask for additional cards ("hits"), one at a time, until they are satisfied ("standing") or they bust. They have the option of doubling their bet and taking just one card (a "double down"). A hand with a pair (10-cards need not be identical) can be split to make two hands, with an additional card added to each. These are then played normally. Some tables permit doubling down after splitting, some don't. If a split card is dealt a card of the same value, a "resplit" is allowed up to as many as four hands, but a pair of aces may be split only once and each gets only one card. If a player's two original cards are an ace and a 10, that is a "natural," popularly called a Blackjack. Instead of getting even money he gets 1-1/2 times the bet unless the dealer has a natural also, in which case he ties. Other than that a dealer's natural means all players lose, even those with a non-Blackjack total of 21. When the dealer's up-card is an ace, players are offered a side bet (called "Insurance") on whether the down card will give the dealer a natural. They can place up to 1/2 their original bet to take that wager, which pays 2 to 1 if successful.

When all players have played their hands in turn, the dealer plays his. He must hit if his total is less than 17 and must stand on 17 or more. The table rules may require the dealer to hit a "soft" 17 like A,6 (which is advantageous to the house). A soft hand is one that can count an ace as either 1 or 11. Players win (even money), tie, or lose their bet depending on whether their total exceeds, ties, or is less than the dealer's total. If the dealer busts, those who have not busted are winners with any total. A thorough discussion of the rules can be seen at *www.blackjackinfo.com*, "The World's Most Popular Blackjack Website."

Three skills are required for winning at 21: (1) evaluating the favorability of the remaining cards and betting accordingly, (2) playing hands accurately, and (3) doing (1) and (2) without arousing suspicion of doing them well. In Nevada, a casino can legally bar a player from the game if his skill seems excessive. Skill (3) requires "camouflage," looking and acting like a typical stupid gambler who is destined to be a loser. Using whiskey as a "deodorant" earlier is helpful.

Evaluating Favorability ("Counting")

The MIT team strategy was used against games having four or more decks dealt out of "shoes," not the single or double-deck games in which cards are hand-dealt. While the odds slightly favor the casino at the beginning of dealing, as cards are dealt the odds fluctuate between favorable and unfavorable to the player. Tens and aces are good for the player (e.g., more naturals and successful double downs), while small cards are bad (the dealer is less likely to bust). Recognizing when the remaining cards favor the player is the aim of "counting." The book refers to their use of "a highly technical count" to evaluate favorability. Well, the count they used is the very simple Hi-Lo, with cards 2 through 6 counted as +1, ace and 10s as -1. It is a count suggested for beginners, not as accurate as some others.

A so-called "counter" using Hi-Lo merely maintains a running count of the number of low cards seen, while subtracting the number of aces and 10s When the total is positive, the remaining cards are favorable to the player. How favorable? The count derived during play is called the "running count," with must be adjusted to make it a "true count." This means dividing the count by the number of decks remaining. A running count of +18 is a true count of +9 if two decks remain undealt. The rule of thumb is that each positive true count represents a player advantage of 1/2 of one percent. Since a shoe is typically that unfavorable to begin with, the true count must be reduced by one before judging the current favorability. A true count of +9 becomes +8, which multiplied by .005 is .04, which means a 4 % advantage for the player.

Bet Sizing

Obviously the size of a bet should be related to both the favorability of the wager and the available bankroll. If you bet too much when the odds are in your favor, you can endanger your bankroll; bet too little, and you miss out on some good profits. It therefore is logical to practice "fractional betting," wagering fractions of bankroll based on the favorability of the bet. A popular principle for sizing bets in favorable situations is known as "Optimal Betting" (OB), aka the "Kelly Criterion," named after J. L. Kelly Jr, who published it in *The Bell System Technical Journal* in 1956. Its goal is to maximize the probable growth rate of bankroll. This is equivalent to having a logarithmic utility function, as the probability of losing half of the bankroll is the same as for doubling it, an attractive balancing of moderate risk with large potential gain. If that seems too risky, betting a smaller fraction reduces the chance of losing half the bankroll, while increasing the time required to double it. Many find that more comfortable. OB is explained in detail on my web site, under "Blackjack Topics."

If a wager is simple win-loss, the OB bet size is a fraction of current bankroll that equals a bet's mathematical advantage ("edge"). When flipping a coin biased 51-49 (2% edge) in favor of heads, the OB for heads is 2% of the current bankroll for each flip. Those who would bet 4% could make a lot more money, but the most likely outcome is that their bankroll would be unchanged in the long run (after large swings of fortune). Those who would bet an even larger percentage are most likely to end up losers in the

long run, and the swings will be even more extreme.

If the possible results of a bet have a wide variance, as with a complex game like 21 (which can have multiple payoffs or payouts per hand that exceed the original bet size), the advantage must be divided by the variance (standard deviation squared) of the results to determine OB. The variance of 21 depends on the rules in force, including the number of decks, but is typically between 1.2 and 1.3, let's say 1.25. When the advantage is .04, that must be divided by 1.25 to get the right fraction for betting, which is .032 (3.2% of bankroll).

Since each positive Hi-Lo true count (after subtracting one for the house) represents approximately a 0.5% advantage, we can say that OB dictates a bet size of .005 / 1.25 of bankroll x (true count -1). For a $25,000 bankroll, the OB would then be .004 x 25000 = 100, indicating an OB of $100 x (true count -1). If the bankroll grows to $50,000, the OB would double to $200 x (true count -1), and if the bankroll shrinks to $12,500 (just as likely) the OB would become $50 x (true count -1). So it boils down to this: Establish a proper "unit" for OB purposes, which is .004 x current bankroll. Then multiply the unit value x (true count - 1) to get the right bet size. Of course you can't conveniently bet units of $27 or $58, so just round down to chip values, $25 and $50 in those cases. Rounding down is safer than rounding up, which would be overbetting.

Playing Strategy

The majority of 21 games have a very small house advantage, less than 1%. This assumes a player uses a set of rules called "basic strategy" that was developed with the help of computers in the early 60s. For each two-card hand and each dealer up-card, basic strategy dictates whether you hit, stand, double down, or split a pair. Very few know basic strategy, even though it takes only an hour or so to learn, plus perhaps a few hours practice. The typical gambler plays so badly that the house makes about 4-5% on his bets. One reason is that many correct plays are not intuitively obvious. For instance, basic strategy says that a pair of 8s should always be split, even when the dealer shows a 9, 10, or Ace; A7 ("soft" 18) should be hit vs dealer's 9, 10, or Ace; and the Insurance bet should not be taken regardless of one's hand. Few players know these things, even though tables of basic strategy are widely available. The web site *blackjackinfo.com* provides an attractive layout for any set of rules, including number of decks used.

Optimal playing strategy often differs from basic strategy, as many actions depend on the current true count. Splitting 10s violates basic strategy, but is correct against dealer's faced 6 when the Hi-Lo true count is +4 or more in a 4-deck game. If he wants to maximize profits, a counter must both play and bet according to the count. That is much harder than just using basic strategy, as many strategy tables incorporating count requirements for various non-basic plays must be memorized. Actually there is not much to be gained from most strategy variations, but those justified only by a high true count should be learned because there could be a lot of money on the table. With an original bet of $150 and dealer showing a 6, a high count justified my splitting and resplitting 10s until I had four hands. The dealer busted, so I won $600. Had I played basic strategy, merely standing with the two 10s, I would have won only $150. Sound good? Consider that losing $600 was a good possibility too, even though the odds favored my action. The most profitable deviation from basic strategy, by far, is taking Insurance when the Hi-Lo true count is +3 or more. It is then likely that more than 1/3 of the remaining cards are 10s, making the 2-1 payoff for a winning Insurance bet favorable to the player.

Tax Consequences

The IRS requires that gambling winnings be reported as income, but losses can be deducted up to the amount of winnings. Winnings must be recorded as gross income but losses are claimed as itemized deductions, so reporting net winnings is not allowed. Deducting expenses related to winnings is very problematical, but non-personal expenses like airfare might pass if a player spends something like eight hours a day in the casinos. Court cases in which bettors tried to deduct expenses have been weak and unsuccessful. In any event, reported losses and related expenses may not exceed the amount of winnings.

Good record keeping is essential. The famous bridge player Oswald Jacoby was unable to substantiate losses claimed to offset unreported winnings of approximately $200,000. His income and losses were reconstructed by the IRS using bank records. For failing to keep good records he was hit with a $50,000 negligence penalty, later reduced. However, the courts have been inclined to give credible taxpayers some leeway concerning inadequate records. Records can be restricted to sessions of play, even though a literal reading of the law would require each bet's win/loss to be recorded--quite impossible. Realistically, the casual bettor's gambling activities are not likely to come to the attention of the IRS unless he is "lucky" enough to win a large amount.

Large slot and Keno winnings are automatically reported to the IRS and withholding taxes apply. Table games are exempt from this requirement. Instead they are subject to the Currency Transaction Report by Casinos (CTRC) Casinos. A CTRC must be filled out for cash and chip transactions (in or out) with players that total $10,000 or more in a single day. Subjects of a CTRC must have their identity reliably verified, and the CTRC includes the social security number. Moreover, proofs of identity must be re-verified periodically. Kevin says he used “legal aliases” but his true social security number. All aliases are legal unless used for defrauding, opening a bank or credit account, or sidestepping any legal obligation, so I guess this usage was legal.

MIT Team Play

A more efficient way to beat the game than playing one-on-one against the dealer is to form a team. Members of the MIT team described in the film and book were of three types: Spotters, Gorillas, and Big Players (BPs). Spotters sit at different tables making minimum bets and counting, signaling a nearby Gorilla or BP when the count is quite high. That count is relayed by a clever oral code to the entering Gorilla or BP so he will know how much to bet. In the film the Spotter crosses hands in back to indicate a high count, which must look rather strange to casino personnel. In the book the Spotter folds his arms, which is more reasonable.

The Gorilla is a high-profile seemingly wild bettor, pretending to be drunk, perhaps loud and obnoxious, with one aim of driving other players from the table so he doesn't have to share a rich shoe with them. Getting the minimum bet size increased does *not* have this effect (as the book claims), since a "grandfather" policy lets existing players continue with lower bets. The Spotter relays the *true* count (I assume) to the Gorilla, who does not count and makes sure the pit boss knows that. Instead he relies on the Spotter, who stays at the table, to count and signal when to raise or lower the bet. It isn't said explicitly, but apparently the Gorilla plays basic strategy.

A BP enters the table similarly, but is signaled the current *running* count (I assume), which he continues to update on his own without help. He too should be a good actor, looking like an obnoxious high roller who throws money around. Unlike the Gorilla, he must be a very strong player who knows how to adjust bet size and vary playing strategy in accordance with the true count. The reason for a Gorilla class

apparently is that skillful BPs are rare. The Spotters usually stay at the table when the BP sits in, evidently in order to verify the BP's wins or losses. However, Spotter play consumes good cards that would otherwise go to the BP.

Ken Uston's Team

Ken Uston, one of the best 21 players ever, had numerous teams playing in the 1980s, as described in his 1986 book, *Ken Uston on Blackjack.* There were only two classes of player, Counters and BPs. They worked together at a table, the Counter signaling the BP to join the table by putting hand on cheek. Thereafter the Counter continued counting, signaling the BP when to raise or lower his bet and how to play (hit, stand, double-down, or split). A BP could drink as much as he wished for camouflage, as long as he bet and played as directed. They took on single and double-deck games as well as shoes (why not?). The count they used was the Uston Advanced Plus/Minus Count, more accurate than Hi-Lo.

For a while Uston and his players used small hidden computers to evaluate the remaining cards and to direct the play of the hand. Naturally the casinos took this hard, and were able to make computer usage a felony, ending that game.

The Counters were very expert, a result of many hours of practice. Still, Uston says the teams had only a 1% overall advantage over the house. They won in only 60% (80% with computers) of their play sessions. Uston writes that one Counter-BP pair could play full-time for a month and still have a one in five chance of losing. Similarly four such pairs could play full-time for a week and have the same chance of losing. Comparing these numbers to MIT team results makes the latter seem miraculous.

Investors got 50% of the winnings, Counters 40% (half based on time, half on results) and BPs 10%. They played every day of the week when active, not just weekends like the MIT team. The amount of money won was in the hundreds of thousands, no talk of millions (as the MIT team claims). Note the sensible distribution of payments to participants. Counters needed much more expertise than the non-counting BPs.

Casino Countermeasures

If a player seems too skillful, a Nevada casino can legally bar him from playing. Before that happens, "heat" is usually applied. That consists of pit personnel standing beside the dealer intently watching the player's action. The aim is to intimidate a possible counter so that he leaves voluntarily. Video cameras (the "Eye in the Sky") are ubiquitous, and those monitoring table action can zoom in on any player or dealer. The pit personnel and video surveillant are in constant contact, so that either can tell the other to watch some player closely. Videos are recorded and can be replayed. Identifying counters is just one concern. They are also interested in spotting real cheaters (e.g., players who mark cards so they can tell what is coming out of the shoe before they hit or double down) and cheating dealers (who may make mistakes to benefit a friend or palm a chip for themselves). Just recently two casino dealers in Reno were arrested on suspicion of cheating. They are also looking for innocent dealer mistakes.

Much has been made of face-recognition computer software in use by casinos, which was mentioned in the book, but it is not accurate unless the subject is facing forward and well-lit. A change in pose, lighting, expression, or age; low resolution because of distance; and accessories such as a beard, long hair, or glasses, can fool the system. Maybe in 10 years it will work well, but not now, and certainly not

in the time of the MIT team. The main recognition tools are a book of photos shared by the casinos and the fantastic memory of pit personnel.

Both the film and the book have the MIT team adopting disguises when recognition has become a problem. They had it backwards. When people look at a face and put it in their memories, it is the main feature of the face that gets into their memory bank. That would be eyes usually, perhaps a very large nose, or for men, facial hair. When a clean-shaven man grows or dons facial hair, beard or mustache, or dons a wig, thinking to become unrecognizable, he still gets recognized because his eyes haven't changed. However, if starting out with facial hair, which is then the main recognition factor, shaving it all off later leaves casino personnel with no identifying clue. Dark glasses are not a good idea, as counters are known to use them in order to hide their interest in the cards of others.

The film has Ben being severely beaten (on the casino premises, and with an MIT ID card in his wallet) by members of a detective agency that casinos hired to detect cheaters and counters. This would never have happened in that time period. Successful legal action by those roughed up in previous decades (usually for cheating, not counting) pretty well ended the physical danger.

Further Comments on the Film and Book

What first caught my attention was the simple Hi-Lo count used by the MIT team. Surely these smart people could employ a more accurate count system. Still, Kevin, learning about counting, has a copy of Edward O. Thorpe's *Beat the Dealer*, a 1966 book that featured the Hi-Lo count and was very outdated by 1994, when the MIT story begins. I would have expected something more current, like *Professional Blackjack*, by Stanford Wong, and *The Theory of Blackjack*, by Peter Griffin, which greatly advanced knowledge of the game, or at least Uston's book.

The hero of the film, Ben Campbell (Kevin Lewis in the book), is first seen in a math (Non-Linear Equations) classroom, solving the "Game Show Host Problem" posed by the professor. Featured in a television show, the problem arises after a contestant guesses that the big prize, a car, is behind one of three doors. The host then opens another door, which shows a goat, and asks the contestant if he wants to switch his choice to the third door or stick with his original choice. It doesn't take a genius to see that it's right to switch, but the film suggests that seeing that is brilliant. Ben says his correct answer was "based on statistics," but statistics had nothing to do with it. The 1/3 chance that his first choice was right has not changed, so it's 2-1 that the car is behind the third door. Simple arithmetic, not statistics.

In the film the team is seated in a restaurant booth and "Jill" is asked by another girl whether it is correct to split 8s when dealer's up-card is a 10. To my surprise the answer was, "Against a five or six, it's okay, but against a 10 it's a sucker bet." And math professor Micky, the team's adviser, says she's right! This is ludicrous, something a complete ignoramus might say, as basic strategy is to split 8s always. If these people need a consultant for some future film, I am available for a cheap price.

The film made no reference to a Gorilla, which would have been an unnecessary complication. Ben starts out as a BP on his first trip (!) with the team, also acting as the "Donkey Boy" who carries hundreds of thousands of dollars in his underwear to avoid having it scanned. With a five-person team, why would this task not be shared, instead of having one person with bulging pants going through security? It is common for gamblers to take large amounts of money on their person to Las Vegas, and it is not illegal

to do so unless the flight is going outside the USA. It is probably true, however, that a very big amount might bring in the dog sniffers, and if the slightest trace of drugs is detected the money will be confiscated. But why are they taking so much to Las Vegas? Most of it comes from winnings there, evidently, so why not keep it in a safe deposit box in Las Vegas? Speaking of money, both the book and the film have Ben/Kevin storing hundreds of thousands of dollars in his MIT dorm. Again, have they no safe deposit boxes in Boston? Of course the money gets stolen, conveniently solving the problem of explaining what happened to all the money.

In the book a player grabs drinks from a tray carried by a passing cocktail waitress, one time two vodka martinis and another time a scotch. Has the author ever tried that? Those trays of drinks are for people who have ordered them. If you grab one, the waitress will yell for Security. If you want a drink, you ask a waitress to bring you one. In the book Kevin is playing with three empty martinis glasses in front of him. No one can play well on that much alcohol. In the film Ben is advised by Micky to order "a tonic water with lime at the table and act a little drunk." A smart counter would never do that. You bring a non-alcoholic drink *to* the table-- you don't order one *at* the table-- if you want to act a little drunk. Later in the film it is the tonic water order, together with the Spotter's obvious signal, that catches them when security replays the video of their table. The minimum bets of the Spotter were also noticed, as very few people play the minimum on every hand. They also remarked that Ben did not double down with 11 "when the count was lighter." Why would a BP stay at the table with a negative count? The film has Ben entering a table when signaled, despite the fact that another team member (a Gorilla?) was playing next to the Spotter. Three teammates at one table is ridiculous.

The MIT team spends money in Las Vegas like there is no tomorrow, with Micky in a top-floor suite that includes a grand piano! Team members also stay in nice suites, often in a casino where they play. They spent "a small fortune" on high-quality disguises. Ben frequently tips $100, evidently to give the appearance of being a high roller. They must have had at least one losing trip, but there is only one instance shown of losing at the table. Ben loses control, disobeys the Spotter's instructions, and loses over $200,000. (In the book it was just bad luck, and it was $100,000.) Other than that, the BP seems to win every bet. The game isn't like that. Even with an advantage you lose more often than you win, coming out ahead only because the wins average more money than the losses. The book says a Gorilla's advantage can be "staggering" when the count is high. Given a rare true count of +11, the advantage is a relatively large 5%, but is that "staggering"?

The book says that investors (who put up the bankroll) earn 12% on their investment--12% per what? Per weekend trip, per year, or what? It also states that card-counting literature says the rate of return for counters is 2%. I can't recall such a statement, which anyway is meaningless if a time period isn't attached. The film says 50% of winnings go to Micky, nothing about investors. In his essay at the end of the book, Kevin says investors never received less than a 30% return per year for five years straight. It's all very confusing.

The film shows the team arriving from the airport in a limo and entering the Riviera casino as a group. Teams should not do that; they should go around alone, with a home base in some cheap out of the way place. Why do things that attract attention?

One can count many shoes, a tedious process, without getting a very high count. The book says 4 to 10 Spotters were used. With only four Spotters, the MIT team would be lucky to get a big plus count more than once an hour. So what does the BP do while waiting for a signal? Does he wander around and around? Then he always jumps into a table with maybe 40%-50% of the shoe remaining. High true counts

just don't happen earlier in the shoe. The BP never starts play at a shuffle, and he always leaves at shuffle time. Casino personnel would have spotted such team play very quickly. They had learned a lot from the discovery of Uston's activity.

The book discusses shuffle tracking, in which a clump of known high or low cards is followed through the shuffle procedure. A player can then cut the decks so that a high-card clump will come into play or a low-card clump will not. When a high-card clump is due to come out while playing, a bigger bet becomes justified even if the running count is not high. I may have been the first to publish an account of this procedure, but publishing had a bad outcome. It seems that casino people read publications such as my favorite, Blackjack Forum. Before long the shuffle procedure had been universally changed to ensure a thorough mixing of all the decks, and my counter friends were not happy with me. Since then I have never seen a poor shoe-shuffling technique, and I have to doubt that the MIT team saw any, at least not in Las Vegas.

Another ploy I enjoyed in the 80s was to notice the last card in the shuffled decks, before they were offered for cutting. If the card was high, a deep cut ensures that it comes into play, and if low, a shallow cut ensures that it does not. There was no possibility of cutting so the card went to a specific player, or to the dealer, as the book says is possible. It might have been done if you were allowed to cut very close to the end of the assembled decks. They ddn't let you do that, as the minimum cut was 15 cards. In the book a team member cut exactly 52 cards from the back when an ace was the back card. "If you're good, really good," it is explained, "you can get the dealer to deal you that specific card." Huh? Even if you know where the card is, it will go to the dealer half the time if you're alone at the table. If you're not alone, the chance of getting the card is much less. Besides, cutting exactly 52 cards is problematical, if not impossible. If you are one card off and make a big bet, expecting to get an ace, the dealer gets it and of course has a natural. Not long after I discussed end-card cutting in print, the end card was carefully kept out of view at all the major Las Vegas casinos. I don't understand how these people got to see it.

Kevin learns "when to leave the table and when to start burning the cards." The two actions are mutually contradictory. One burns cards by playing multiple hands and making bad hitting and splitting plays, in order to use up cards when the count is very bad. That gets rid of those little cards, with small bets to minimize the consequent losses. But if the count is that negative a BP leaves the table, he doesn't play.

The book states repeatedly that casino games "are rigged," giving the house a "hefty advantage." With the house advantage of decent 21 games in the neighborhood of a minuscule 0.5%, "rigged" is hardly a descriptive adjective. Even craps isn't so bad, with a 1.4% house advantage if one doesn't take any of the sucker bets (e.g, on boxcars, two sixes). There are some bad 21 games, for example tables that pay only 6 to 5 for a natural instead of 3 to 2. Ignorant gamblers crowd those tables, thinking that 6 to 5 is better than 3 to 2! A counter wouldn't sit there, as the rule favors the house by more than 1%.

As a Spotter Kevin was playing against a six-deck shoe from which five decks were dealt. Such depth provides great opportunities for counters when the fifth deck comes out. However, in the MIT time period (late 90s) I doubt there was any Las Vegas casino dealing that deep from six decks. In Shreveport, LA, yes, but not in Las Vegas. When the count goes high, Kevin signals the BP to come in with the count at +15 and two decks remaining in the shoe. The BP "pushed a seemingly random handful of chips into his betting circle: three blacks, two purples, and six green, a total of $1,450. *Let the Eyes in the Sky figure that one out!"* Never happen. Dealers are required to restack chips in order of size before dealing, largest on the bottom, for the benefit of the pit boss. Kevin is dealt a 10 and a 9, the BP a pair of 10s, and the dealer's up card is a 6. The count becomes 15 -1 -2 + 1 = 13. Divide by two decks remaining and it's

6-1/2, so the BP correctly splits the 10s, receiving a 10 on one and a 9 on the other, and the dealer busts. However, he should have split the first hand again with its two 10s, as the true count was then 5-1/2 (actually more, with fewer cards left in the shoe) and Hi-Lo strategy is to split with +4 or more in this situation. Later he hits with 16 facing dealer's 2, which means the count must have been -9. Then he "takes advantage of a hot streak" and raises his bets. A hot streak means lots of 10s and aces, lowering the count and calling for a bet reduction, not an increase. That was an awful lot of count change within a single deck (the sixth deck not dealt). It doesn't seem possible.

Kevin Lewis (real name Jeff Ma) adds an essay to the back of the book. In it he says that a betting unit should be 1% of the available bankroll. As discussed above, it should be 0.4% unless you want to take the chance of overbetting, not a wise policy. He seems to be unaware of the OB principle and the variance effect. He also says you should play two hands when the count is favorable. That is good advice when not alone at the table, as you want to get more of the good hands than others do. Playing alone with the dealer it's not the best policy. If you play two hands, they are not independent because there is a covariance of about 0.5. You have to reduce each bet by 25% to have the same amount of risk. If the count says to bet $600, OB says to bet $450 on each of two hands, getting 50% more money on the table. However, you are also getting more cards dealt per round, which will mean fewer rounds. The effect comes out about even, except for one thing: the count gets updated more often when playing a single hand, and that is advantageous. When there is only one more round expected before the shuffle, then it makes sense to play multiple hands. Proper bet sizing for three or more hands is provided by Stanford Wong in *Professional Blackjack*.

With all the mistakes, inconsistencies, and obvious exaggerations in the MIT story, it is hard to take it seriously. There was such a team, and it probably made money, but not nearly as much as claimed. The book says they made almost half a million dollars in one weekend. Ken Uston must have laughed if he read that. It is a fun piece of near-fiction, however. I recommend both the film and the book.