# Online bad-beat jackpots: Part 2

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As you may recall from the last issue of *Canadian Poker Player*, my friend, Bib Ladder, asked me a question regarding the point at which it becomes profitable to play at the online hold'em bad-beat jackpot tables. We saw in part one that the exact probability of a qualifying bad-beat semideal for 10-handed hold'em is 1/154,997. We are assuming that in order to qualify, quad 8s or better must be beaten, each player must use her best hand, both hole cards must be used to form her best hand, kickers in her hand count even if they have the same rank as a kicker on board, and a hand qualifies even when it is not best or second best.

A player who throws away hands that might qualify, such as suited 6-3, has a smaller chance of being involved in a jackpot winner. Trying to take a player's individual characteristics into account introduces unnecessary complications. Thus, if a given table has a qualifying semideal, we assume that each player has a 1/10 chance of winning the big end of the jackpot, a 1/10 chance of winning the smaller end of the jackpot, and a 4/5 chance of getting the remaining players' share. This is the first assumption we make.

Players who play more hands tend to win more pots. Such players are then contributing more to the jacpot drop. However, we are going to assume that all ten players contribute the same average amount to the jackpot. This means, on average, each player contributes five cents to the jackpot drop per hand. Again, this is an assumption that ignores an individual player's characteristics.

The toughest assumption with which to deal is the percentage of qualifying semideals that actually make it to fruition. Under the qualifying rules, it is likely that quads will make it because players holding a pair of 8s or bigger are likely to see the flop. The problematic hands are those that would have turned into small straight flushes. Many such hands would be folded preflop by many players. One mitigating factor is that for a large enough jackpot, some players may see the flop with suited cards having a gap of three or less.

After looking through the computational details, I am going to adopt 70% as the percentage of qualifying semideals that are actually realized. Since the probability of a qualifying semideal is 1/154,997, and we are assuming that about 70% of them actually complete, the probability of a bad-beat occurring for a given hand is essentially 1/221,424. Call the latter probability $p$.

When I first mentioned to Bib that the number of tables in action also plays a role, he protested that the number didn't matter. Since the online games are numbered and processed one after another for jackpot adjudication, he used the analogy of standing in a line and being judged only when you reach the head of the line. His analogy of standing in a line is quite nice, but his conclusion based on the analogy is erroneous. You see, once you commit to joining the line — that is, your table starts its hand — all of the tables in front of you in the line will be judged first. Thus, you are competing against all of them for the jackpot, with all of them getting a crack at it before you.

On the other hand, it turns out that the number of tables is not mathematically significant. If there are $N$ tables in front of you, the probability that none of them hit the jackpot is $1-p$ raised to the $N$-th power. Even with 200 tables in line before your table, the chance that NONE of them hit the jackpot before your table has its opportunity is 99.906% — rather close to 100%

Now let's get to the number we promised for Bib. We assume the chance of at least one table hitting before your table is $1/1000$, and the chance of the jackpot being available when your table is judged is $999/1000$. If the jackpot is worth $x$, then the contribution to your expectation for hitting the big end of the jackpot is obtained as follows.

The product of 999/1,000 and $1/10$ and $p$ multiplied by $.35x$ is the contribution coming when no one hits the jackpot before your table. The product of 1/1,000 and $1/10$ and $p$ multiplied by $.07x$ is the contribution coming when a table hits the jackpot before your table. Performing the calculations yields $1,249\times/7,908,000,000$.

We do the same for hitting the smaller end of the bad-beat jackpot, being at the table when a bad-beat jackpot comes, and not getting the jackpot. We then solve for the break-even point by setting the resulting equation equal to zero and solving for $x$. This yields the value of \$158,286, which we round off to \$158,300. In other words, if the jackpot is \$158,300, then paying the jackpot rake shows a positive expectation.

When I finally showed Bib the value just mentioned above, he looked at me and said, "I've been telling people the jackpot should be around \$160,000." When I asked him how he came up with that number, he just shrugged and said he had a feeling.