

Mini Project For Poker

If you go to this website:

https://en.wikipedia.org/wiki/Poker_probability

you will find all of the possible poker hands and the probabilities that they occur. This is based on using the standard deck of 52 cards, each with a rank in $\{1, \dots, 13\}$ and a suite in $\{H, C, S, D\}$, and being dealt a 5-card hand.

We list the probabilities of being dealt some of the hands.

- The probability of straight flush is 0.0000139.
- The probability of four-of-a-kind is 0.002401.
- The probability of a full house is 0.001441.

So

Prob of a straight flush < Prob of four-of-a-kind < Prob of a full house.

What if we had a different number of ranks and suites?

With this in mind, here is the project in parts.

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1. Derive formulas for the probabilities of all the hands at that website if there are s suites and r ranks, and a player gets a 5-card hand.
2. Consider straight flush, four-of-a-kind, and full house. There are 6 ways to order these things types of hands. For which of these 6 ways is there an r, s such that if you have r ranks and s suites, then you get that ordering of probabilities.
3. In the last part I said there were 6 orderings. That is, if we don't include ties. If ties are allowed then there are 13 orderings. For which of these 13 ways is there an r, s such that if you have r ranks and s suites, then you get that ordering of probabilities.
4. CHECK your work by using simulations.
5. Note that the three hands Straight Flush, 4-of-a-kind, Full House have no obvious order. So its plausible that any order could happen (this may not be true, but it could be true). By contrast, if I had chosen the three hands: 1-pair, 2-pair, 3-of-a-kind then clearly there is only one ordering. There are other combinations whose ordering is not obvious. I list some. There may be others. For each set of hands, where any ordering is plausible, do what we did above for Straight Flush, Four-of-a-kind, Full house.

Here are some to look at:

- Full House, Flush, Straight.
 - Flush, Straight, 3-of-a kind.
 - No pair, one-pair.
6. Everything above is for 5-card hands. Do the same thing for 6-card hands. You will need to consider other good hands like
 - Three pairs.
 - Two 3-of-a-kind.
 - A pair and 4-of-a-kind.
 - There may be others.
 7. We won't be looking at 7-card hands as that leads to to many new hands to look at.

8. (This is not about cards.) How many ways can 4 horses finish a horse race, allowing ties? 5 horses?