Various Constructions

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1 Motivation

HungryHorse poker is well known for asking you to "consider the inverse question": when you arrive at the river with a value hand, ask yourself what size your bluffs want to go. Then go slightly smaller with your value hands.

This approach has a lot of merits. It forces people to consider bluffing. It makes them range their opponents. Players doing these two things engage their brains, and are thus massively advantaged for that alone. Additionally, it forces them to test a hypothesis on the size they should go to induce a particular response.

However, major flaws include that if you think your opponent folds range (100% of range) to 100x pot and your assumption is wrong by 5% (97.5% $\pm$ 2.5%,) then ripping it all in is a massive punt. More generally, HungryHorse asks you to construct a maximally exploitative strategy for a fixed opponent strategy, WITHOUT weighing the expected amount your strategy slips to uncertainty about your opponent's strategy. Other pages on the poker section deal with more than this.

This page just constructs examples of situations where your value and your bluffs may want to go the same size.

1.1 Nuts or Air, maximally exploitative

Suppose we have either the nuts or air. The pot is 1, we have infinite stack depth. We know if we bet B, our opponent calls $f(B)$ fraction of their range. This is independent of our strategy, and we want to maximally exploit our opponent.

The optimal size for our nuts is

$$\text{argmax}_B(Bf(B)+1) = \text{argmax}_B Bf(B)$$

where we win the pot, and win our bet when our opponent calls. Similarly, the optimal size for our bluffs is

$$\text{argmax}_B(1-f(B))1 - B(f(B)) = \text{argmin}_B(B+1)f(B).$$

So we want to construct $f(B)$ such that

$$f(0) = 1, \text{argmax}_B f(B)B = \text{argmin}_B f(B)(B+1)$$

Let's quickly note that for $f(B) = \frac{1}{B+1}$, the latter term is just 1, and so going all in maximizes our EV with value and we are indifferent between all bluff sizes.

Now, let's construct a case where we actually *prefer* the same size B^* with nuts and air, so that this value B^* is the unique argmax/argmin for our two values. Note $B^* \neq 0$ as this would imply

$$\text{argmax}_B f(B)B = 0 \implies f(B) = 0 \forall B \neq 0 \implies \text{argmin}_B f(B)(B+1) = (0,\infty) \not\ni 0.$$

Then we instantly get that $f(B^*)(B^*+1) < 1$ However, f can't be 1-differentiable at a finite B^* since then at B^* we need that

$$[f(B)(B+1)]'@B^* = [f(B)(B)]'@B^* = 0$$
$$\implies f'(B^*)[B^*+1] + f(B^*) = f'(B^*)(B^*) + f(B^*) = 0$$
$$\implies f(B^*) = 0$$

And now our value bet doesn't print more than bet 0/check.

1.2 All in

Let's try $B^* = \infty$. At this point, we construct an example. The motivation for this example was to fix $f(1) = \frac{1}{4}$ and make it optimal for a stack size of 1, and construct f to make this value optimal. We can construct

$$f(B) = \min(1, \frac{\frac{1}{4B} + \frac{1}{2(B+1)}}{2})$$

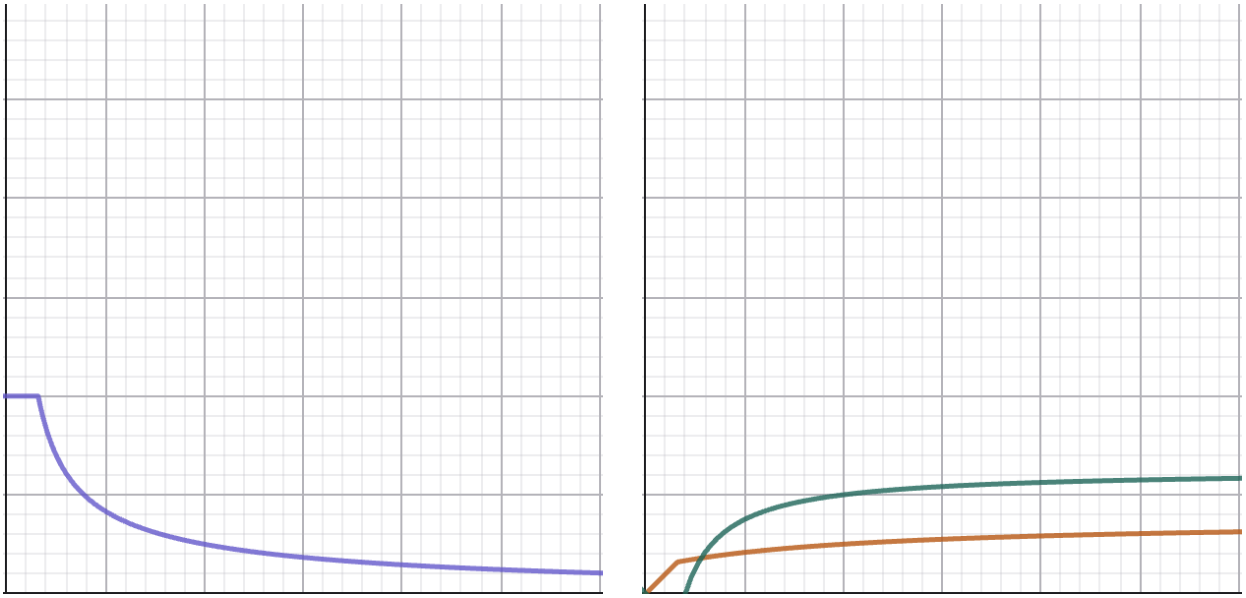


Figure 1: Left graph: a satisfactory function $f(B)$ vs B. Right graph: EV of bluff (green) and value bet (orange) vs bet B. The axis ticks are 1.

There exists a similar C^∞ solution, and likely a simpler one than I've given here.

1.3 Extensions

There are a few natural extensions:

1. What is the set of all continuous functions $f(B)$ for which all-in is optimal with nuts, air?
2. What if we beat only $k\%$ of our opponent's range, and they call linearly? Can there be other optimal values B^* in this case, and how else does our strategy change?
3. Can we have a noncontinuous function for which there is a value $B^* \neq \infty$ optimal?

Email me with the answer to any of these questions and I'll add it to the PDF, with credit.