# Kami Ranking

Debating which clan is best positioned in the game is a classic pastime. Is Cat better than Shrimp? Sure they win against most everybody, but the Butterfly matchup is impossible. Yada, yada, yada… Handling the rock-paper-scissor aspect of matchups is always the tough part, that's what we aim to solve here.

Legend tells that Hantei became the emperor after defeating his brothers in a tournament. They fought each other in sequence, the loser leaving the challenge. An ok idea, but the Kami didn't consider that everything could've been different if they fought in a different order. Inspired by that, but bringing some better math to the table, I present the Kami Ranking strategy.

## The concept (the tournament of the kami as a Markov chain)

The odds of winning a game do not depend on previous results, as each game is independent. You chance of winning this game has nothing to do with the previous game. That makes a tournament a Stochastic Process.

Assuming a single elimination tournament, the accumulated matchup results can inform the expected result of a game. On a Shrimp vs Cat matchup, if the overall records are Shrimp wins 80% of games, we can assume Shrimp will survive and Cat will be eliminated. If we assume a single elimination tournament, in which a random clan A steps in then faces another random clan B, then the winner stays and faces another match against random clan C ,then the winner stays and faces another match against random clan D, and so on and so on… that can be described as a Markov Chain.

Now imagine such a tournament, being run with infinite rounds. Eventually a patter emerges that points the statistical prevalence of each clan as the overall winner x% of the time regardless of the rock-paper-scissor, as the matches are random. That is the stationary state of that Markov Chain.

Once we model the matchups as a Markov Chain, we can build a matrix to represent the transition of its states by using the matchup win rates. With that matrix we can find calculate the stationary state, giving us the spread of each clan in the winner.

## From matchups to Markov matrix

To simplify the explanation I'm gonna work with only 3 clans, but the exact same logic works for the 7 clans. Or even larger numbers in case we decide to split by Stronghold being played, or something else.

Take 3 clans Cat, Shrimp, and Butterfly with the following win rates:

- Cat wins 2 of 10 against Butterfly
- Cat wins 7 of 7 against Shrimp
- Shrimp wins 7 of 10 against Butterfly

**Cat to Butterfly:** 80%! When Cat faces Butterfly 80% of the time Butterfly stays. Yes, we care about the losing record here. It's the chance of Butterfly surviving against Cat. **Cat to Shrimp:** 12.5%! I Yes, going straight by the numbers it should be zero. **This is a special case**. We handle small samples and it is possible to get 100% results, but it is reasonable that no matchup is absolutely impossible. Given more

games, Shrimp would eventually get a win. To account for that we assume that the next game would have a different result, so we will treat this as if Cat wins 7 of 8 against Shrimp. The same will be done on the loser side. The advantage of handling it like this is that the largest the amount of victories, the smaller is the adjustment to reflect how hard it must be that matchup. This adjustment will ensure our Markov Chain is irreducible.

Then: Shrimp to Cat 87.5%, Shrimp to Butterfly: 30% Butterfly to Cat: 20%, Butterfly to Shrimp: 70%

Now we normalize those rates, assuming each clan has the same chance of stepping into the ring. So for 3 clans we will divide each value by 3 for each matchup, and you should get the remaining percentages from that sum on your own clan (as that’s your chance of winning)

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           |  Cat  | Shrimp | Butterfly
Cat        | 0.688 | 0.042  | 0.270
Shrimp     | 0.292 | 0.608  | 0.100
Butterfly | 0.067 | 0.233  | 0.700
```

## The final ranking

With that matrix above we find the stationary state for it. It’s more math than I would like to explain here. Nothing too complex, but you’d learn it better somewhere else.

Applying it to that example data we would get: Cat 376, Shrimp 336, Butterfly 287. (I choose to multiply the results by 1000, to reinforce the fact they should be compared relative to each other, and not directly as percentages)

Those can be interpreted as the relative strength of the clans. The numbers by themselves don’t mean much, but they can be compared to check their power levels. In that example, after all is said and done, Cat is 12% stronger than Shrimp. And 31% stronger than Butterfly, even if their direct matchup is terrible for Cat , cause Shrimp should make up for keeping Butterfly out.