Jane Street IN FOCUS – Blotto Puzzle

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1 What's your entry?

Castle	C1	C2	C3	C4	C5	C6	C7	C8	C9	C10
Points	2	19	43	26	8	2	0	0	0	0

2 How did you go about coming up with it?

2.1 Summary

Using Monte Carlo methods, I generated random strategies and pit them against each other in a round-robin style tournament. I copied the attributes of the top-scoring strategies for the next tournament, also including other possible strategies I figured others might try to use. Many, many games later, I reached my resulting strategy. To check its performance, I ran my result against different kinds of competitor strategies.

2.2 Using Random Strategies

I randomly generated bias values for Castles 1 - 10, using the cube of a random uniform distribution. These values were normalised to the maximum score of 100 points. The strategies produced by this method were varied with points greatly fluctuating between each castle. Below (Figure 1) are examples of the strategies produced by this method.

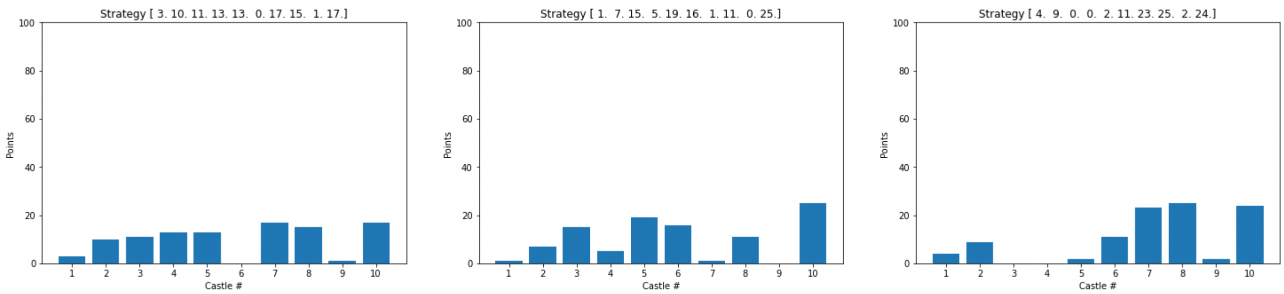

Figure 1: Initial random strategies.

2.3 The First Run

I then generated 10,000 random strategies and played them against each other, and noted the few with the highest scores, shown in Figure 2. Notice that many of the best plays are shaped like a distribution curve skewed to the left. Seeing these observations, I theorise that the ideal strategy should be shaped the same way. This shape can be modelled with the beta distribution, allowing the next tournament to be easily populated with similarly shaped strategies to further refine the end result.

2.4 The Beta Distribution

100 samples are randomly drawn from a beta distribution which returns results in range [0...1]. Each result is interpolated and rounded off (mapped) to an integer value between [0...9] which acts as a

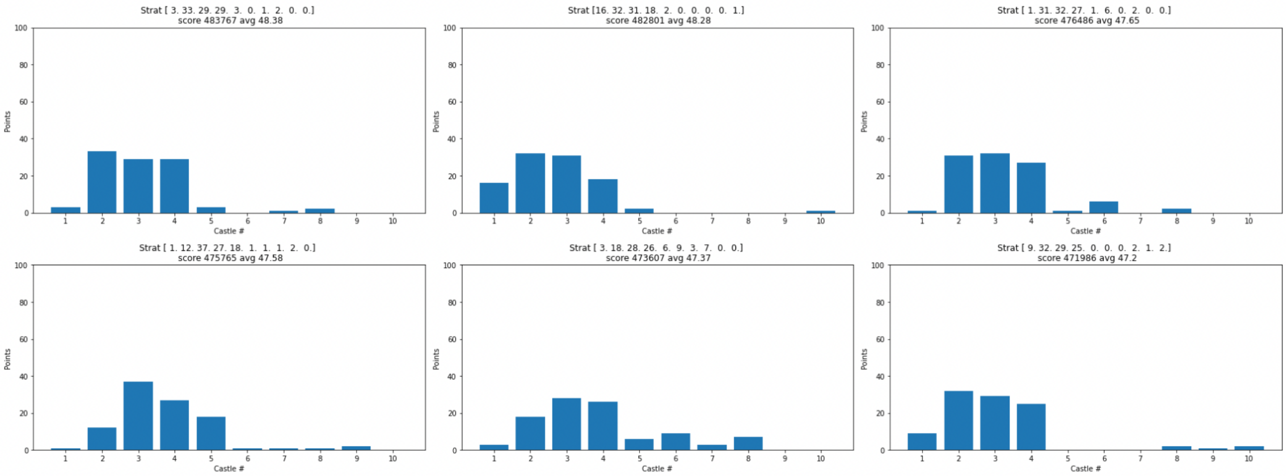

Figure 2: Top 6 scoring random strategies.

frequency tally for the bar graph of castles, then normalised for a total of 100 points. Essentially, I used a histogram to roughly model the beta distribution accounting for 10 castles and the 100 points maximum. With suitable parameters, such left-skewed strategies are produced, shown in Figure 3:

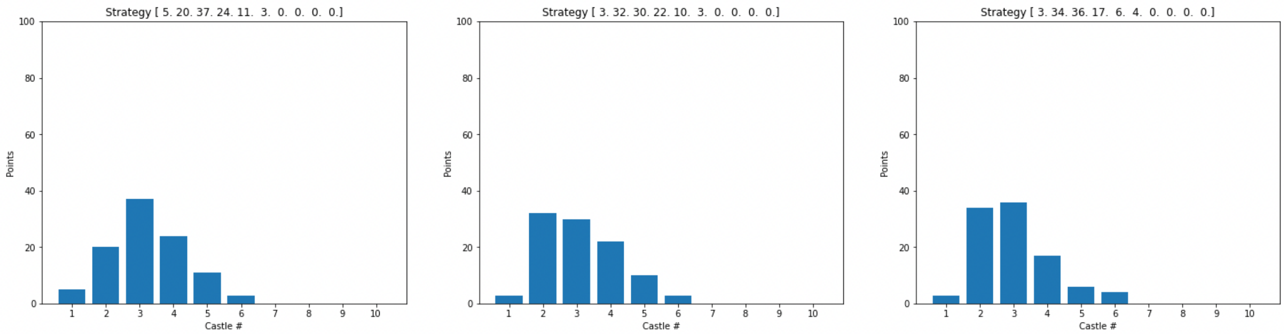

Figure 3: Beta distribution strategies.

2.5 Comparison with Potential Strategies

Consider the strategies in Figure 4. I chose them because they seemed to be variations of likely strategies chosen by other Jane Streeters. The first one maximises all its points in the first three castles to strike out opposing strategies, winning instantly. Another variation of this strategy (the second graph) maximises Castles 3-5. The last graph is Beatrice's strategy, a good balance of points between all the castles. Additional strategies not shown here can be found in my code submission.

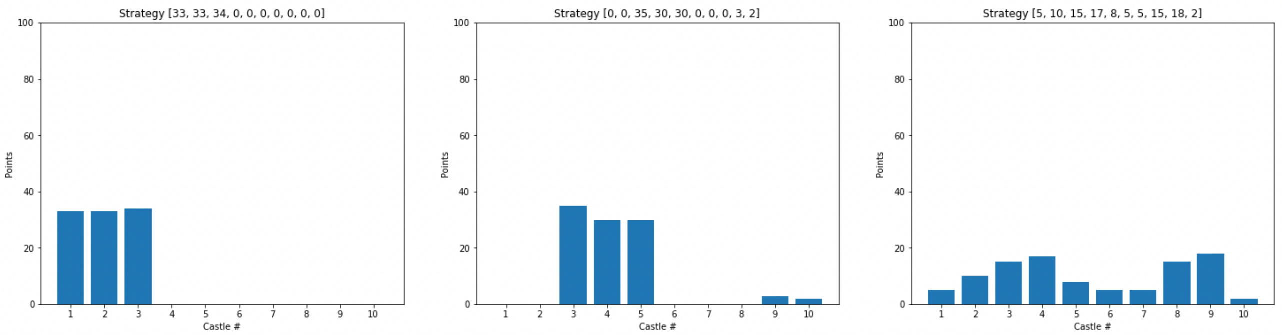

Figure 4: Custom strategies chosen by me.

2.6 The Next and Final Tournament

Finally, I run a mix of over 30,000 strategies against each other. This mix consists of custom strategies, random strategies, and the beta distribution strategies. I skewed the beta distribution strategies to both the left and right to induce more noise and variation into the tournament population. I also included the beta distribution for $\alpha = \beta = 1$, which is a random uniform distribution.

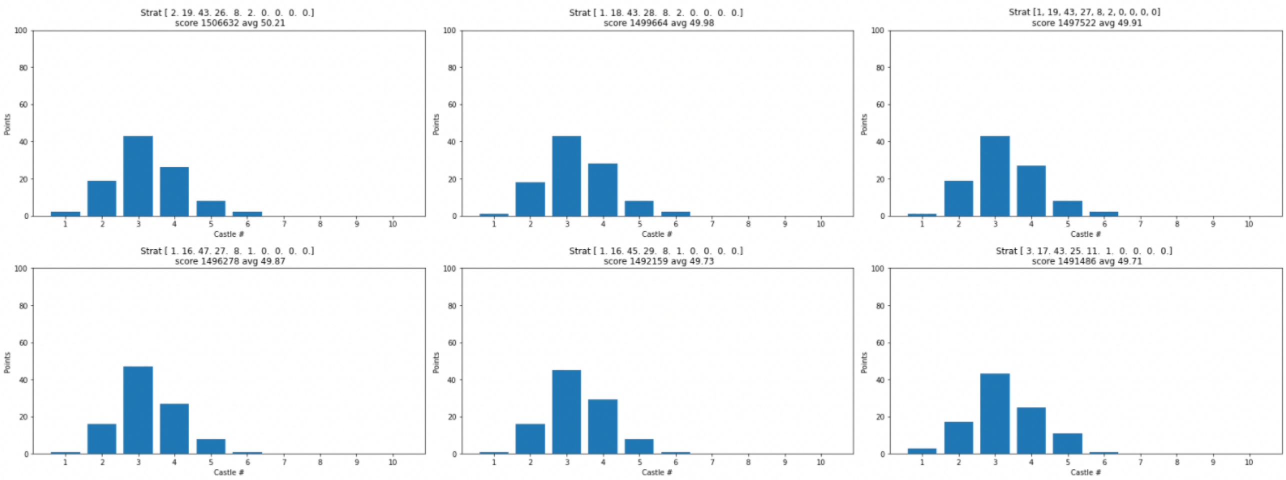

Figure 5: The top 6 performing strategies out of the population of 30,000.

After close to half a billion rounds of playing (just over 30 minutes), we are greeted with the (relatively superior) best-performing strategy that is [2, 19, 43, 26, 8, 2, 0, 0, 0, 0].

It is interesting to note that all top performers shared a similar shape, and none of the custom strategies I added made it to the top 100. Repeated tournaments with this strategy against different populations show that this strategy still performs consistently near the top. The results agree with my theory that the ideal strategy involves some sort of a skewed distribution. If the ideal strategy were to be shaped differently, it would have risen to the top ranks. It is very likely that other variations of distributions and shapes have been created and accounted for in the vast number of generations.

Thus concludes my result for the Blotto Puzzle. All the code for this paper can be found attached as a Python Notebook in my submission, broken down step-by-step.