MATH3531
Simulation and Modelling
Final Project
Monopoly

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Introduction

For our final project, we decided to build a simulation of Monopoly.
Our design is relatively simple. We utilized "Player", "Tile", and "Game" classes along with a main loop to simulate individual games of Monopoly. These game instances will run until a player has become the only player who avoided bankruptcy and therefore has won. We have a "house_rules" option to toggle whether a game instance uses the house rules or not. One issue we ran into was games running forever as the initial rents are too low to eliminate players. Players are able to make their way around the board and pass GO, collecting $200 faster than they can lose the money in rent. To resolve this, we just created an inflation variable that increases the rent every 50 turns. This decision was arbitrary and can be changed to observe changes in the results. Our base scenario or control, is 50,000 games with 4 players, and an inflation rate of +1 in rent every 50 turns. We then ran the program changing the amount of games, the amount of players, and the inflation rate and observed the changes.
We followed the rules of monopoly based on this website (the link in the pdf didn't work):
`https://www.monopolyland.com/category/rules/`

Results

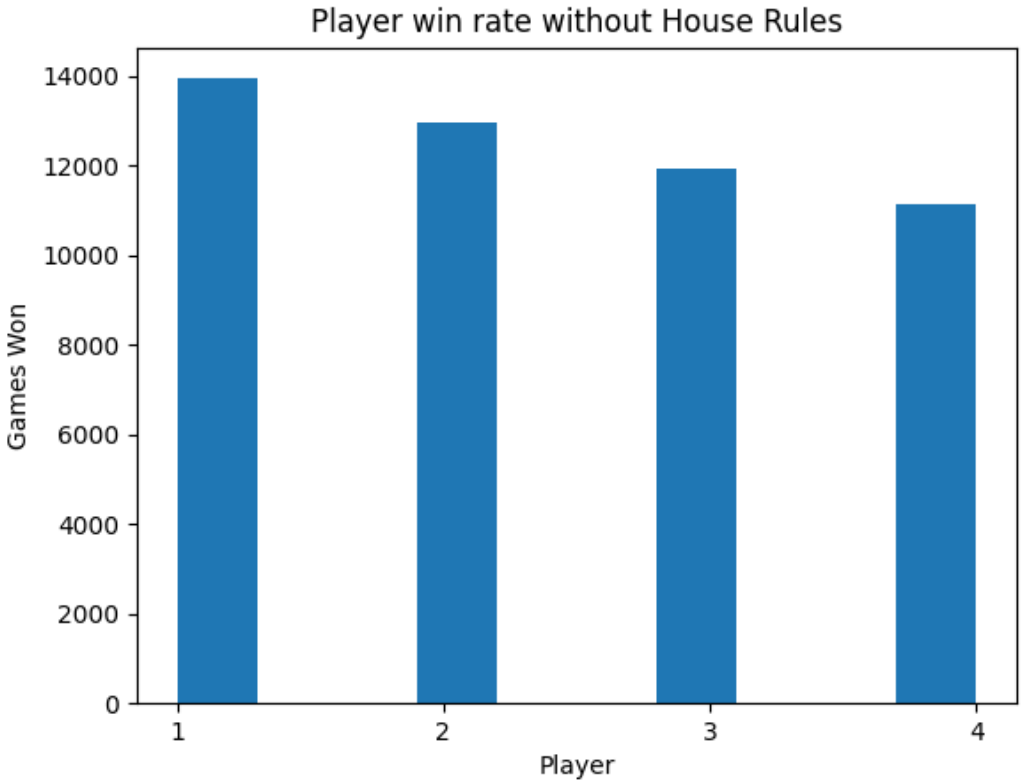
Scenario	Games	Players	Inflation	House Rules	Average Turns	Order Matters	average trip
Control	50,000	4	50 turns +1	OFF	485	YES	20
Control	50,000	4	50 turns +1	ON	552	YES	30
More Games	100,000	4	50 turns +1	OFF	485	YES	20
More Games	100,000	4	50 turns +1	ON	553	YES	30
Less Players	50,000	2	50 turns +1	OFF	139	NO	1
Less Players	50,000	2	50 turns +1	ON	553	YES	13
Higher Inflation	50,000	4	50 turns +3	OFF	135	YES	6
Higher Inflation	50,000	4	50 turns +3	ON	171	YES	6

From our findings, we see there is no difference in the amount of games played, the average turn per game remains the same, the order matters, Player 1 and 2 perform much better than players 3 and 4. The average amount of trips around the board before all properties are bought also remains the same.
When we change the amount of players in the game, we notice a big difference when house rules are applied or not. When house rules are not used, the average amount of turns was 139, player order did not matter, and the average amount of trips before all properties were bought was 1. This is mostly due

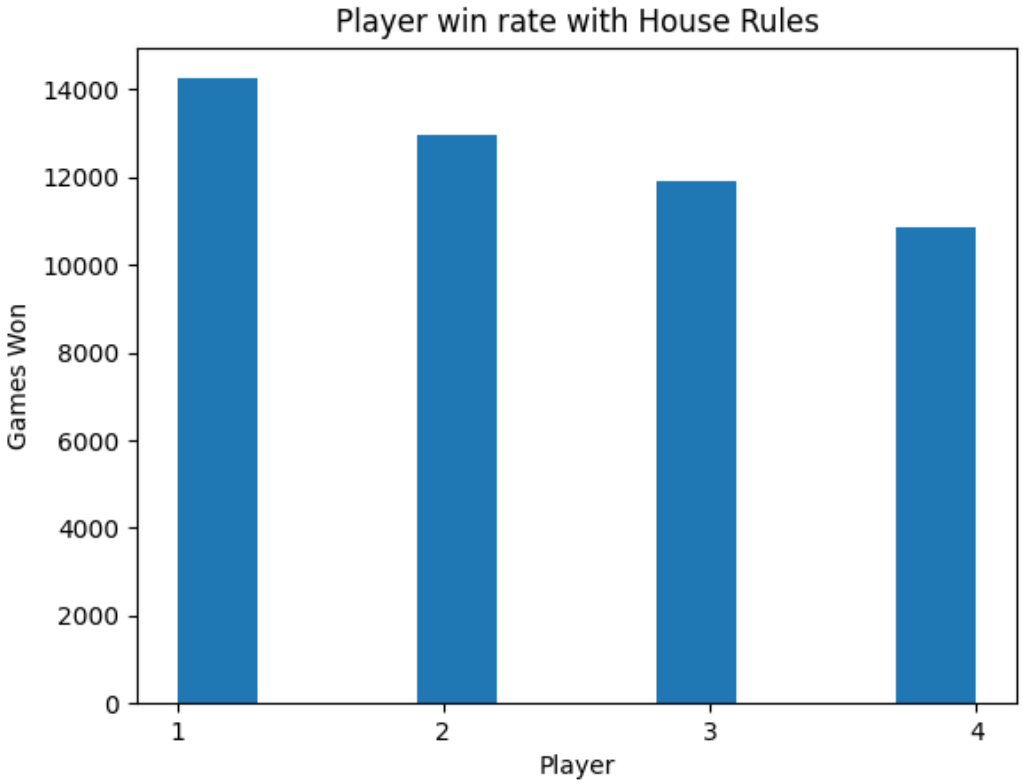
to a lot of games ending before all properties were bought. However, when the house rules were used, the order did matter, the average amount of turns went up as did the average trip before all properties were bought.
Changing the inflation rate really only affected the average amount of turns for games and trips around the board before all properties were bought.

From this, we can conclude player order does matter, except for fewer players and no house rules. We can also say that the house rules do affect the average turns and average trip, however this would make sense as gaining $500 dollars on free parking and not auctioning properties would extend the length of games and the amount of trips before all properties are bought.

Control

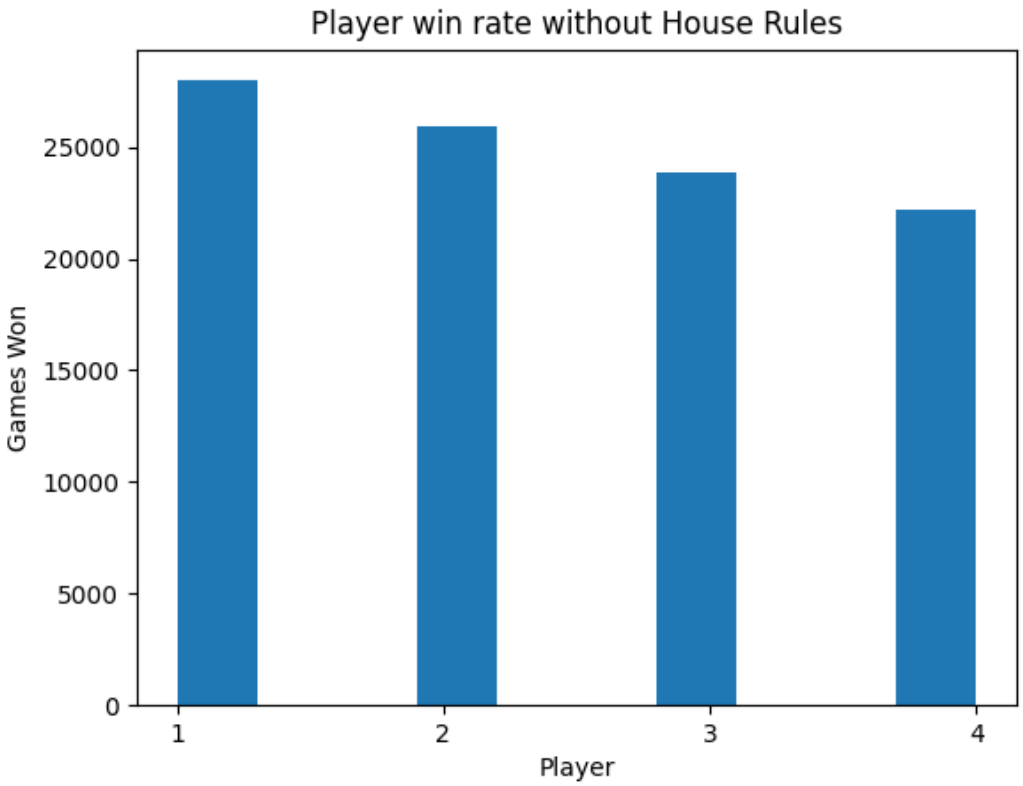


```
House rules: OFF
50000 Games took on average 485.03458 turns and on average  19.83708 loops around the board before all properties bought
```




```
House rules: ON
50000 Games took on average 552.45136 turns and on average  30.25958 loops around the board before all properties bought
```

More Games




```
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tDocs/Canada/MountAllison/WINTER2023/COMP3531 - Simulation & Modelling/Project/comp3531_Final_Project/Monopoly.py"
House rules: OFF
100000 Games took on average 485.40123 turns and on average  19.84506 loops around the board before all properties bought
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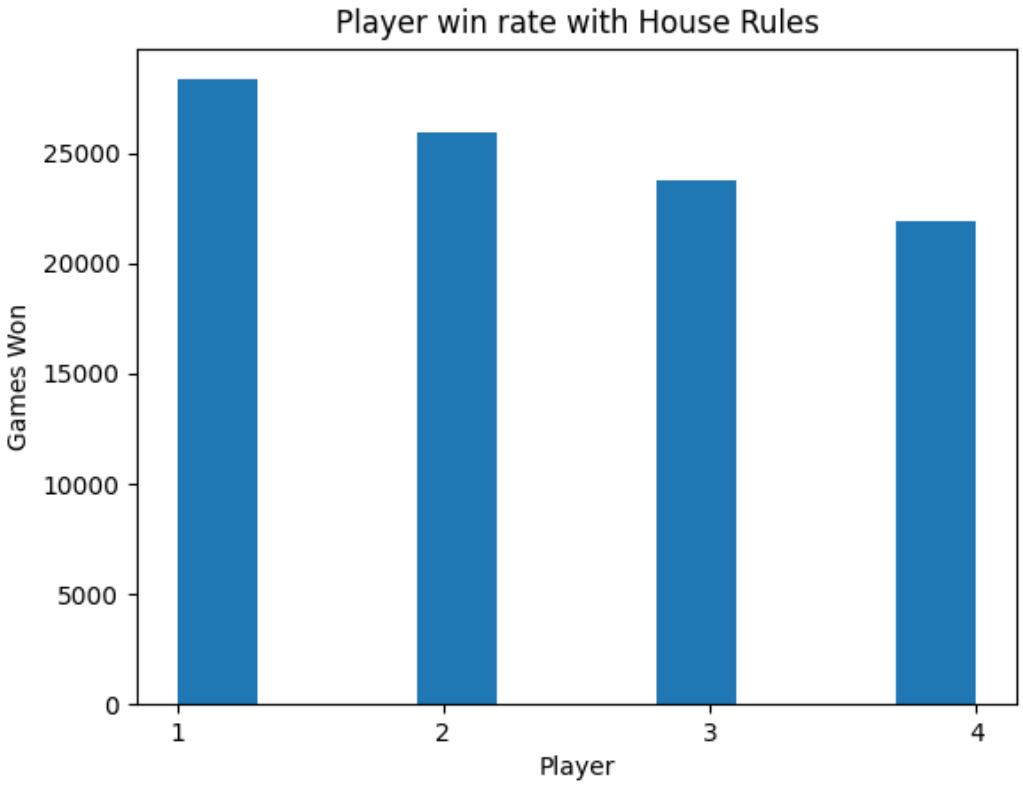
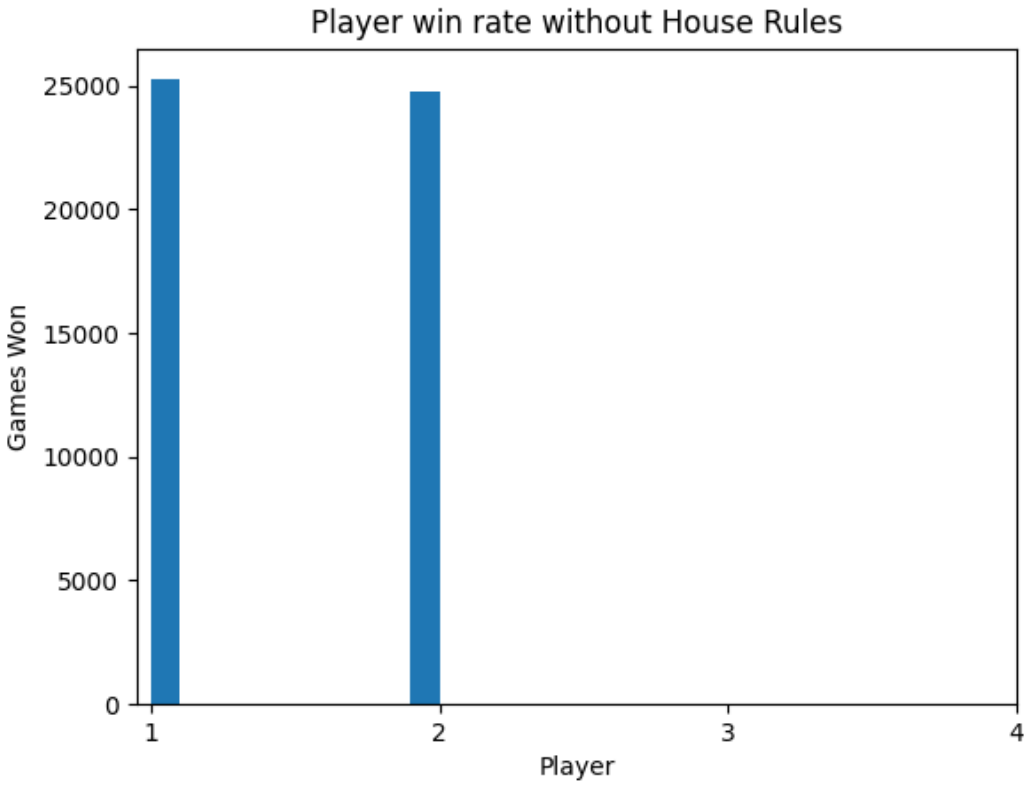



```
House rules: ON
100000 Games took on average 553.53948 turns and on average  30.1831 loops around the board before all properties bought
```

Less Players




```
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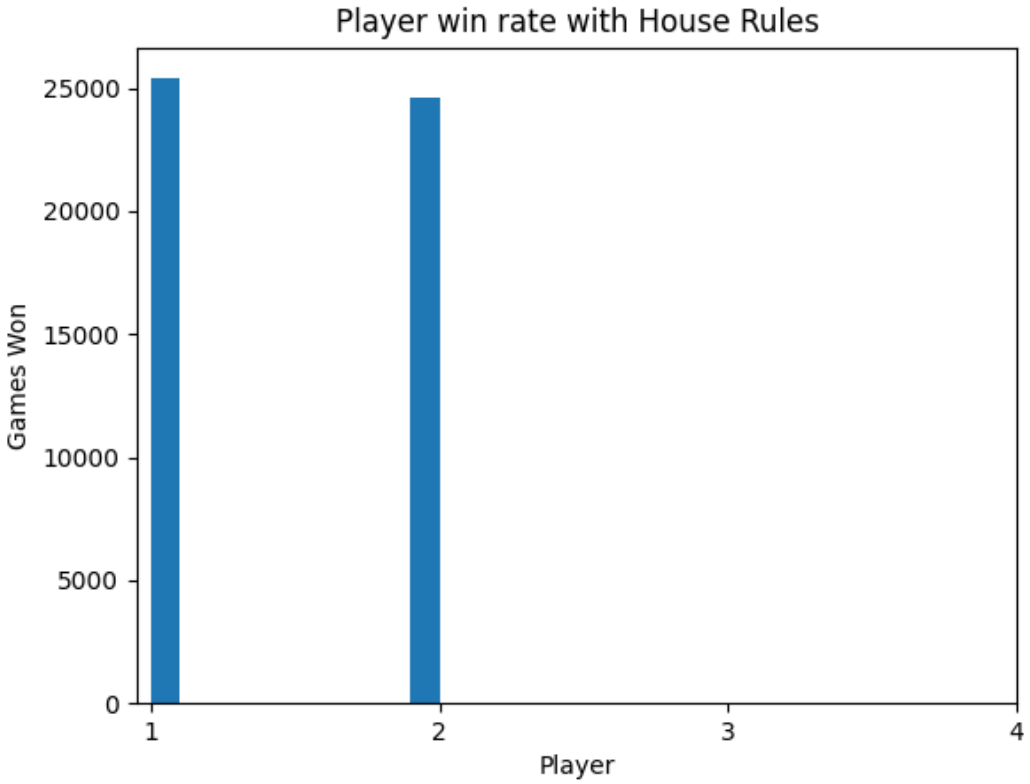
House rules: OFF
50000 Games took on average 138.67562 turns and on average  0.99706 loops around the board before all properties bought
```




```
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House rules: ON
50000 Games took on average 553.22212 turns and on average  12.65624 loops around the board before all properties bought
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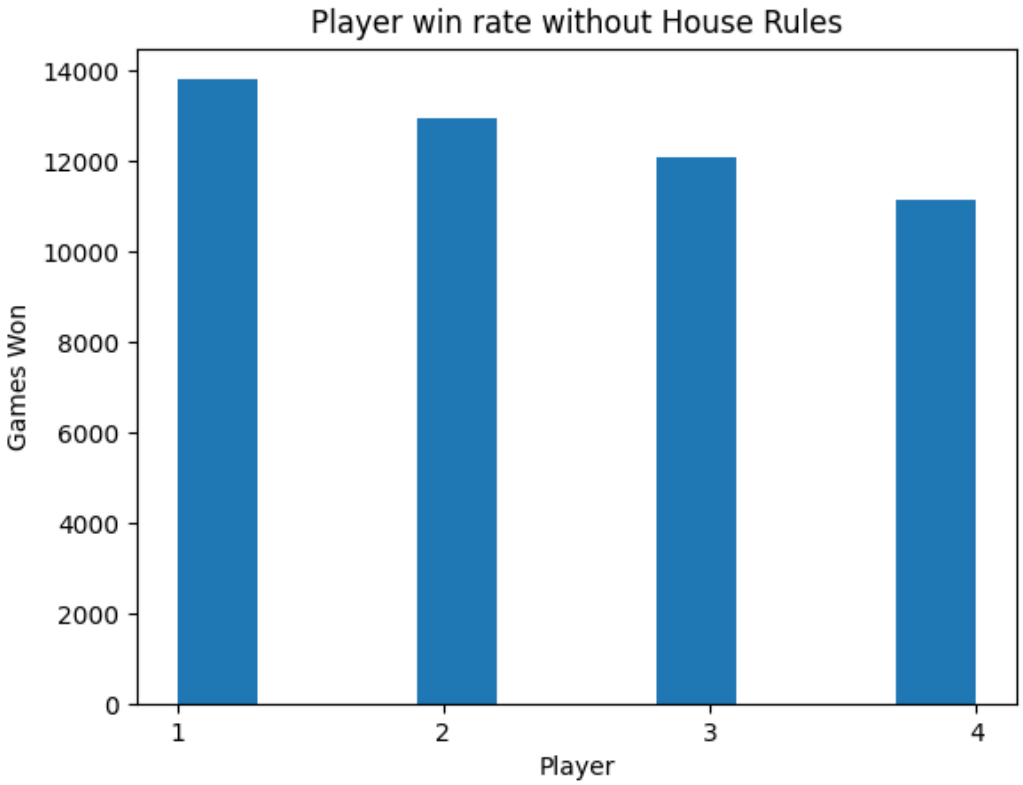
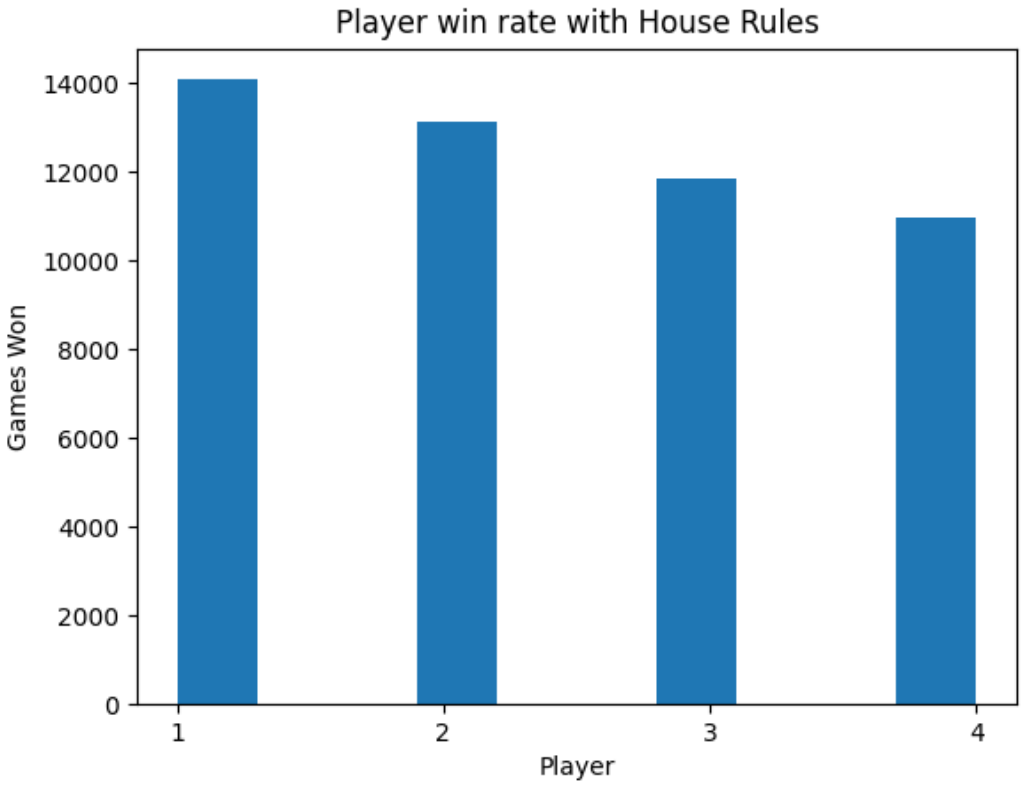
higher Inflation




```
House rules: OFF
50000 Games took on average 135.42474 turns and on average  6.44248 loops around the board before all properties bought
```




```
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House rules: ON
50000 Games took on average 170.93256 turns and on average  5.75422 loops around the board before all properties bought
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```