# Pity Me,
# I Play Genshin Impact

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# What is Genshin Impact?

- Genshin Impact is an open world MMORPG game developed by miHoYo
- Genshin has a special loot box system called **wishes**
- Players can spend either in-game currency or real money for the chance of getting a new character or weapon
- Characters and weapons are ranked from **1** (worst) to **5** (best) stars
- **The best characters on average, require more rolls to obtain**

# The Pity System

- To prevent player overspending, Genshin Impact features a **pity system**
- The more a player spends without getting a rare character, the more likely they will get a rare character

**Rates**

| Item | Base Rate | Average Rate including Pity |
|---|---|---|
| 5★ Character | 0.6% | 1.6% |
| 4★ Character or Weapon | 5.1% | 13% |
| 3★ Weapon | 94.3% | 85.4% |

# Our Questions

Does the pity system work as miHoYo claims?

How does the pity system evolve as the number of unsatisfactory rolls increases?

# Data Cleaning

- Most of data was easily read
  - pulls.csv
  - wish_total.csv
- wishes.csv
  - Included list values in cells that used the same delimiters
  - Had to change delimiters and parse strings into list objects

```
data = './data/Raw/wishes.csv'

with open(data, mode='r') as inp:
    reader = csv.reader(inp)

    with open('./data/Raw/wishes_clean.csv', mode='w') as out:
        for i, line in enumerate(inp):
            out.write(re.sub('\{[^]]*?\}', lambda x: x.group(0).replace(',', ';'), line))
```

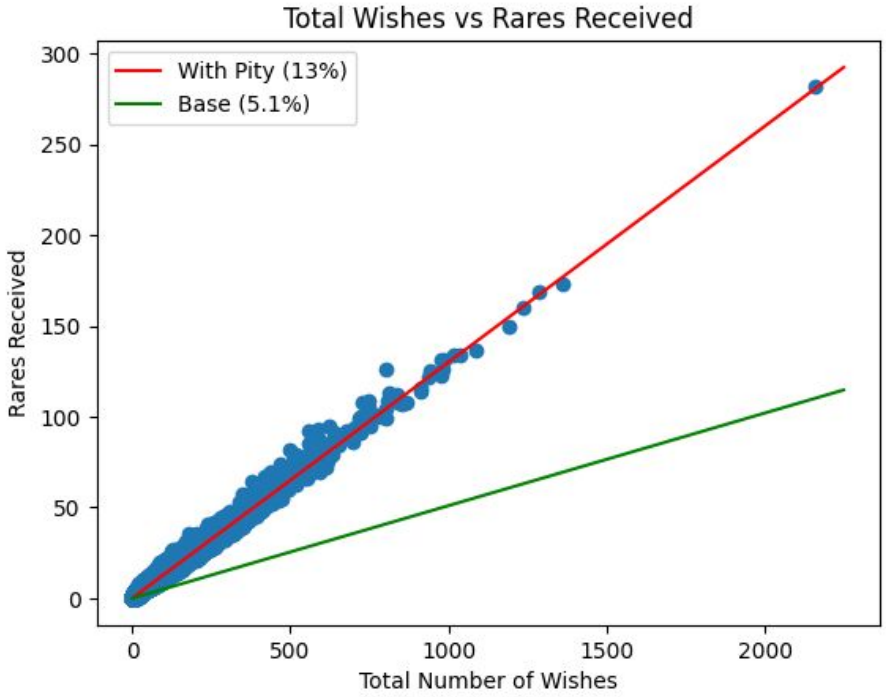
```
def clean_info(test):
    test = test.replace('{', '[')
    test = test.replace('}', ']')
    test = test.replace(';', ',')
    return test

wishes_raw = pd.read_csv('./data/Raw/wishes_clean.csv')
wishes_raw['rarePity'] = wishes_raw['rarePity'].apply(clean_info)
wishes_raw['pityCount'] = wishes_raw['pityCount'].apply(clean_info)
wishes_raw['rarePity'] = wishes_raw['rarePity'].apply(eval)
wishes_raw['pityCount'] = wishes_raw['pityCount'].apply(eval)
wishes_raw.head()
```

# Initial Observations (Rare)

There is a clear linear relationship between the total number of wishes and the number of rares received.

Data fits nicely with given pull percent for rares.

There are more rares received than expected because players stop pulling when they get what they want.




$R^2 = 0.9783$

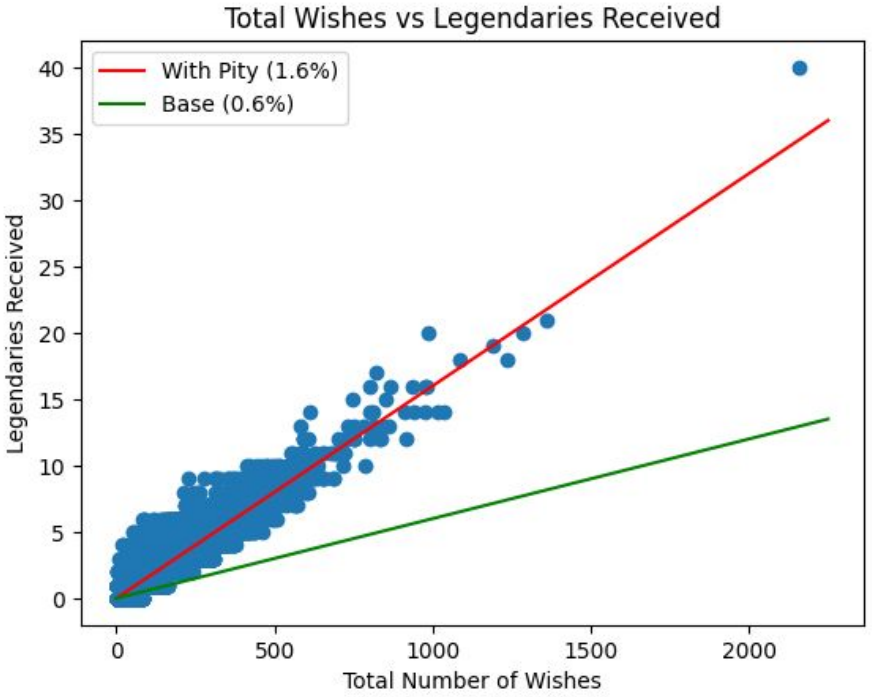
# Initial Observations (Legendary)

There is once again a clear linear relationship.

Data fits nicely with given pull percent for legendaries.

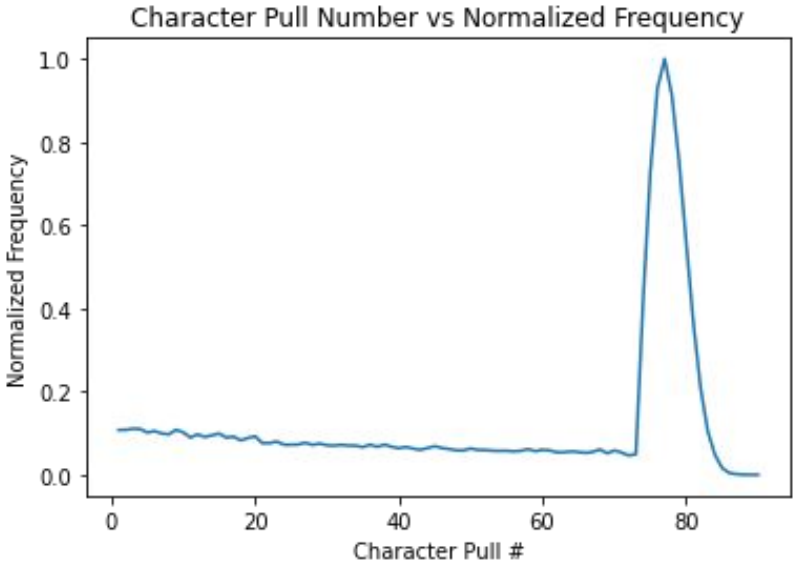
There are more legendaries received than expected because players stop pulling when they get what they want.

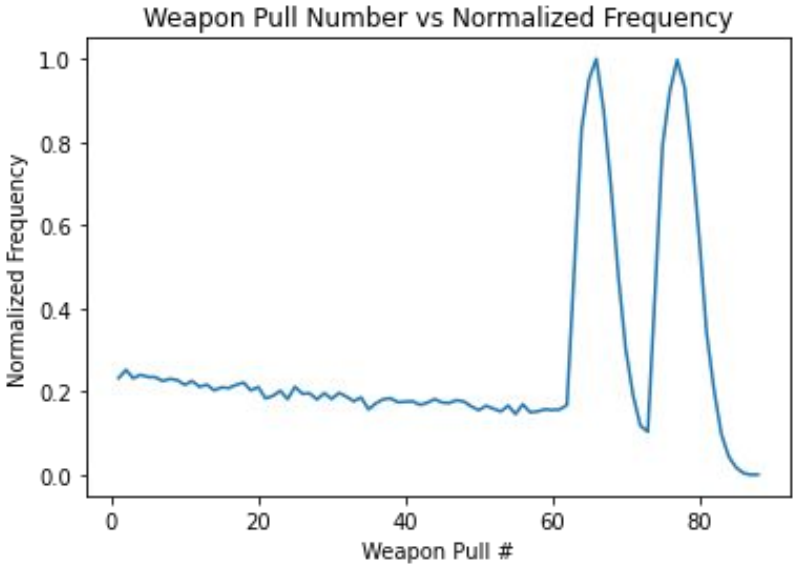
Higher spread is attributed to scarcity of legendary pulls. Players are also more likely to stop pulling after getting a legendary than after getting a rare.




$R^2 = 0.7177$

# Looking Closer at Pull # vs Frequencies of Legendaries



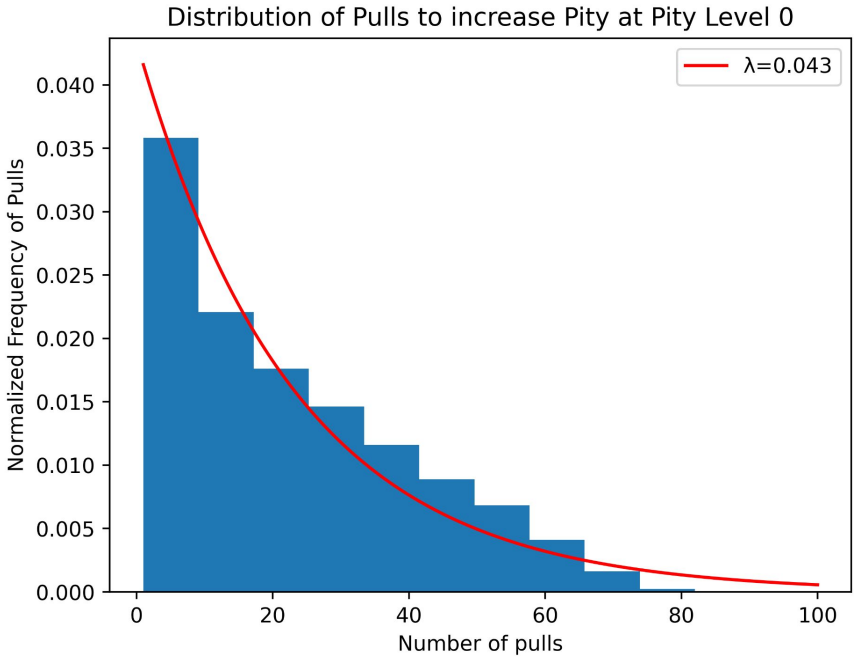



# Further Analysis of Pity

# I. Pulls Needed to Increase Pity Level at Given Pity Levels

Exponential Distribution PDF

$$f(x;\lambda) = \begin{cases} \lambda e^{-\lambda x} & x \geq 0, \\ 0 & x < 0. \end{cases}$$



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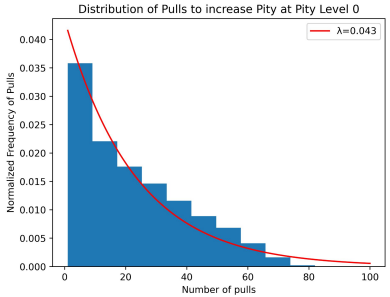


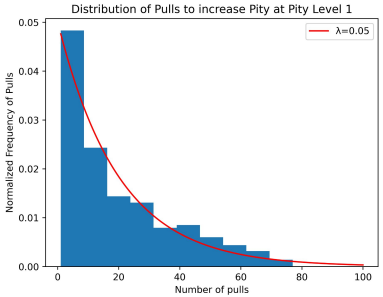


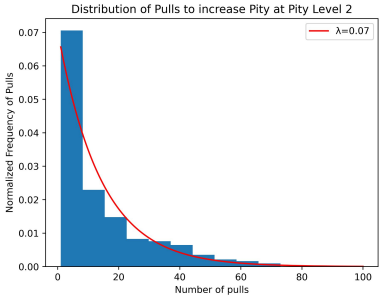


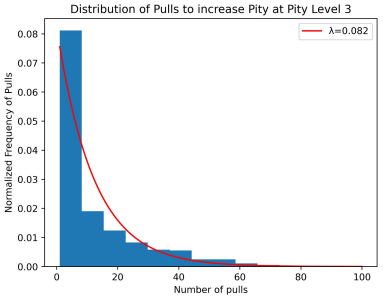


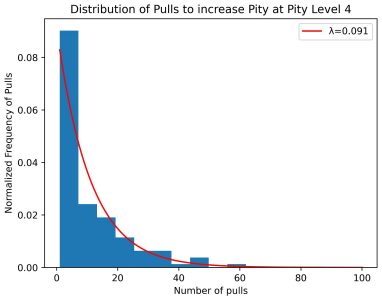


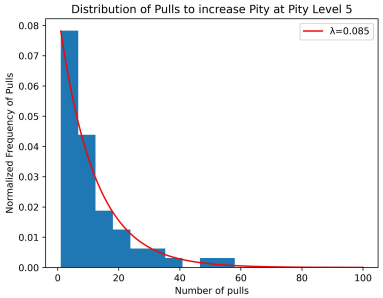


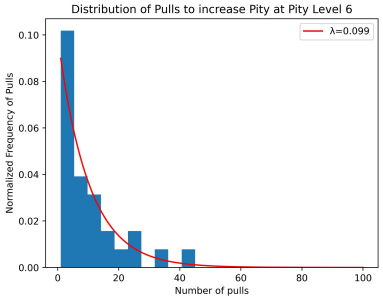


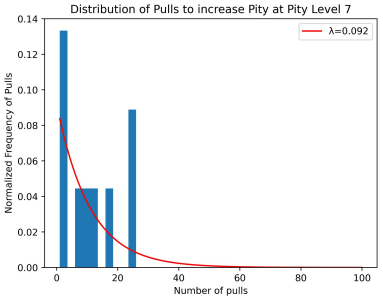

# II. Pulls Needed for Legendary at Given Pity Levels

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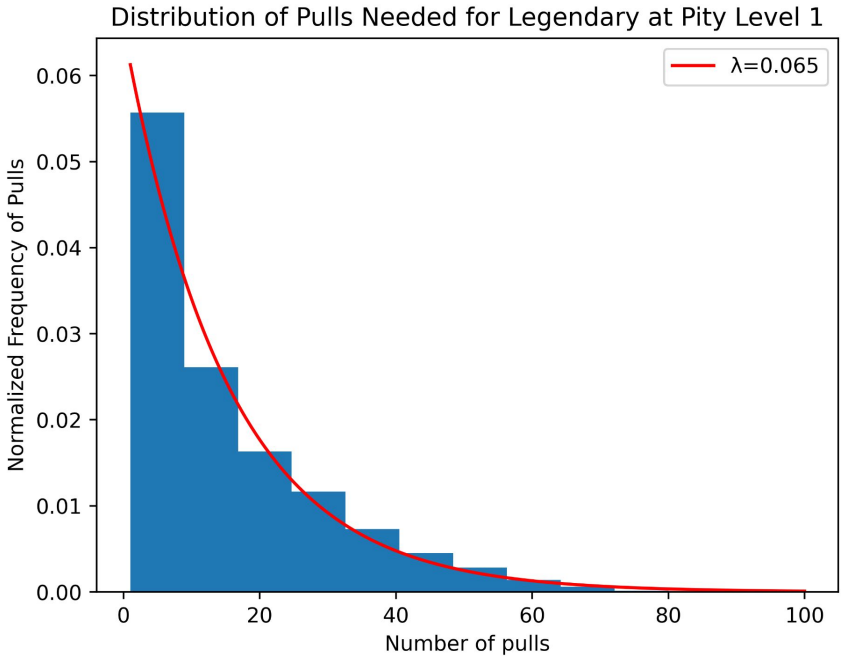

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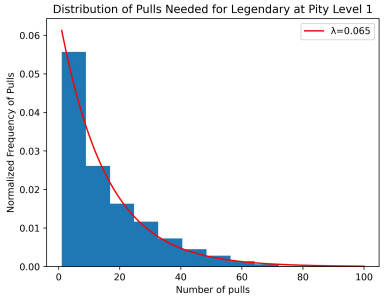
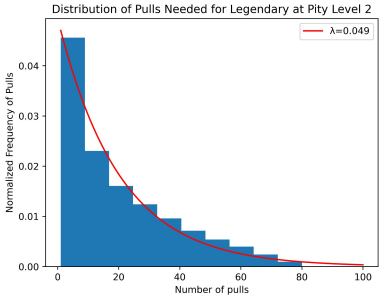
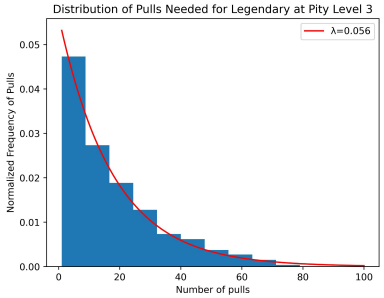
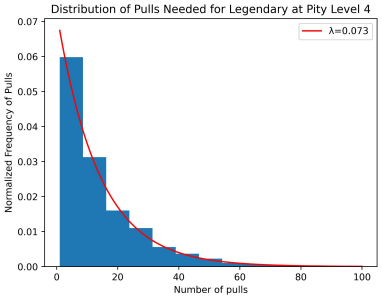
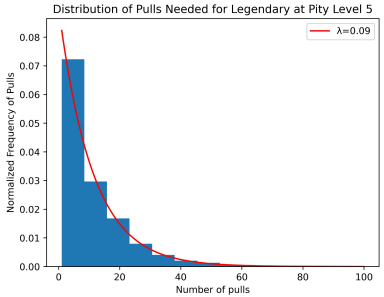
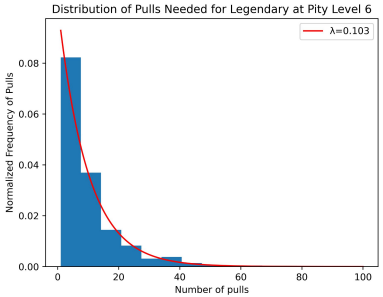


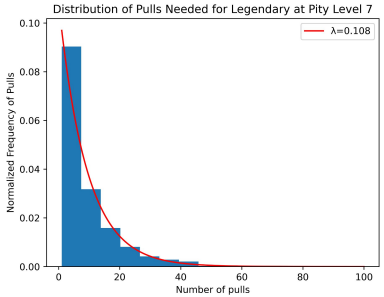



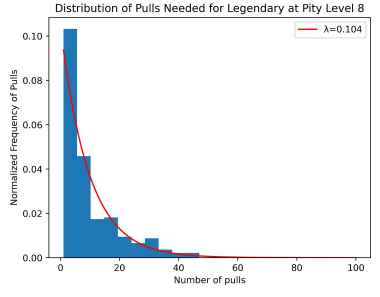



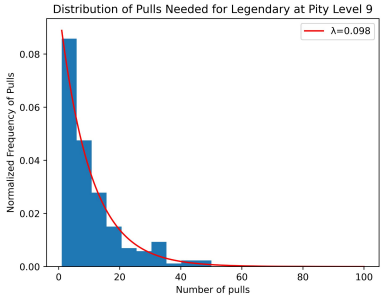



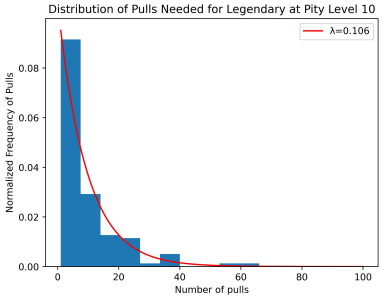



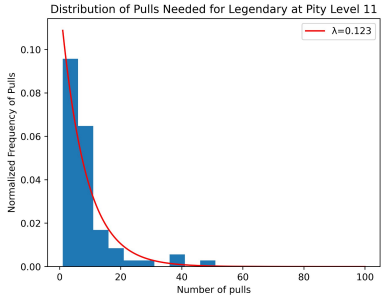



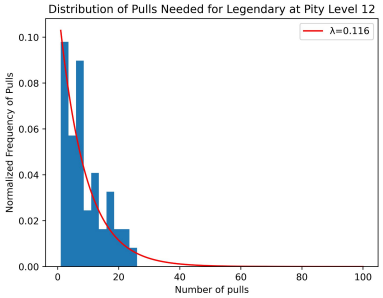



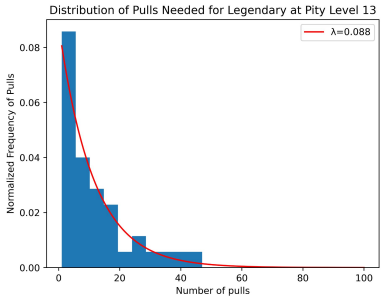
# Pulls Needed for Legendary at Given Pity Levels (Cont.)

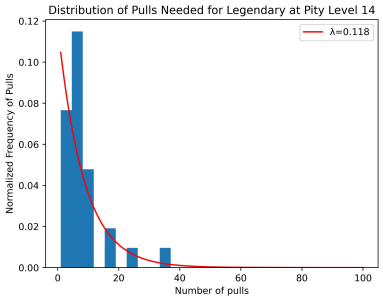


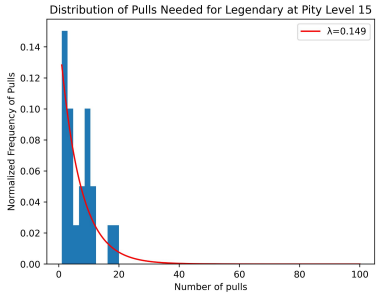



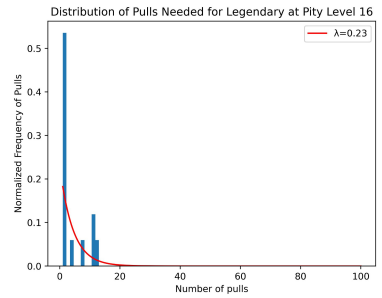



# Culmination of these Finding

Parameter Values from Analysis

Random Variable

$$\prod_{i=0}^{n} X_i \sim \Gamma(n+1, \frac{1}{\sum_{j=0}^{n} \lambda_j}) \text{ where } \lambda_j = \frac{1}{\overline{x}_j}$$

Product Notation

Distribution of the Random Variables

# Future Improvements

- Try to better understand why λ parameter values for distributions are not monotonically decreasing

- Expand our research to include specific characters, weapons, and dates