Increase Pokémon Player Tournament Standings Through Pokémon Battle Predictions

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Business Problem

For this project, the goal is to predict the outcome of Pokémon battles based on individual Pokémon characteristics as well as results from previous battles. The models and predictions will be utilized by professional Pokémon players in order to stay ahead of the ever-evolving strategy, meta, of the game. In turn, those professional Pokémon players will consistently do well at tournaments.

Background / History

The Pokémon franchise was created in 1996 by Satoshi Tajiri and managed by The Pokémon Company. The franchise started with the release of two video games in Japan called Pocket Monsters: Red and Pocket Monsters: Green. These two games were later adapted for release in the United States as Pokémon Red and Pokémon Blue. The quick success of the two video games led to the release of the Pokémon Trading Card Game (TCG) and Pokémon Manga. The entirety of the media mix franchise has seen rapid international success. Since then, there have been over 122 video games released, over 189 card sets, 1,234 episodes, and 27 movies.

Both the Pokémon video games, and the Pokémon TCG are competitive in nature. In the video game, a player plays as a trainer with the intention of creating the best six Pokémon team to battle non-player characters (NPCs) and players alike. In the Pokémon TCG, players build 60 card decks to battle other players to become champions.

Because of the rapid success of the Pokémon franchise and the competitive nature of the games, The Pokémon Company established the Play! Pokémon division in 2003. Play! Pokémon was responsible for hosting competitive eSports tournaments from the local, regional, national, and international levels each year. Players can enter these tournaments to compete against one another to earn monetary prizes as well as points to qualify for the Pokémon World Championships. The Pokémon World Championships has over 1 million dollars in monetary prizes alone.

Many of these tournaments occur around the release of a new video game, Pokémon, or card set. These new releases can greatly affect the meta of a tournament. Because a potential meta shift could mean losing if a player doesn't shift with it, players must spend weeks learning new combinations that will give them the best chances of victory. The players that stay at the forefront of the meta are more likely to win tournaments and in turn qualify to compete in the Pokémon World Championships.

Data Explanation

For this project, there are a total of three different datasets which were uploaded on Kaggle. The datasets consist of data from the official Pokémon database, specifically Pokémon characteristics, and from a custom algorithm which created the 50,000 data points for previous battles.

The first dataset which is labeled pokemon.csv contains all the different Pokémon characteristics of each individual Pokémon. There are a total of 12 different columns with 800 different rows. Each row contains information about a single Pokémon. The 12 different columns are as follows: # (Pokémon Number), Name, Type 1, Type 2, HP, Attack, Defense, Sp. Atk, Sp. Def, Speed, Generation, and Legendary. Below is the breakdown of the meaning of each column:

Column Name	Meaning
#	Each Pokémon has a unique ID. This column is the unique ID of each Pokémon
Name	Name of the Pokémon
Type 1	Property of Pokémon that affects the power or strength and weaknesses of moves (e.g. Water). First type of a Pokémon

Type 2	Secondary type of a Pokémon (optional)
HP	Hit Points. How healthy a Pokémon is
Attack	Stat of how powerful a Pokémon's move will be
Defense	Stat of how well Pokémon can defend against attacks
Sp. Atk	Stat of how powerful a Pokémon's special move will be
Sp. Def	Stat of how well a Pokémon can defend against special attacks
Speed	Stat which determines which Pokémon will attack first
Generation	Which generation a Pokémon is apart. Total of 8 Generations in the dataset
Legendary	Whether or not a Pokémon is a Legendary Pokémon which are usually more powerful

In the Pokémon characteristics dataset, there was one missing entry in the name column. After some digging, it was determined that Primeape was the missing name. Additionally, Type 2 had 386 missing entries, but that was acceptable as it is an optional field.

The second dataset which is labeled combats.csv contains information of previous Pokémon battles. There are a total of 50,000 recorded Pokémon battles. These battles were created through a custom algorithm to simulate Pokémon battles that are as close as possible to actual Pokémon battles. There are a total of three different columns: First_pokemon, Second_Pokemon, and Winner. Below is a breakdown of the dataset:

Column Name	Meaning
First_pokemon	Unique ID of the first Pokémon
Second_pokemon	Unique ID of the second Pokémon

Winner	Unique ID of the winner between the two Pokémon

Out of the 50,000 recorded Pokémon battles, 16 Pokémon from the Pokémon characteristics dataset weren't used.

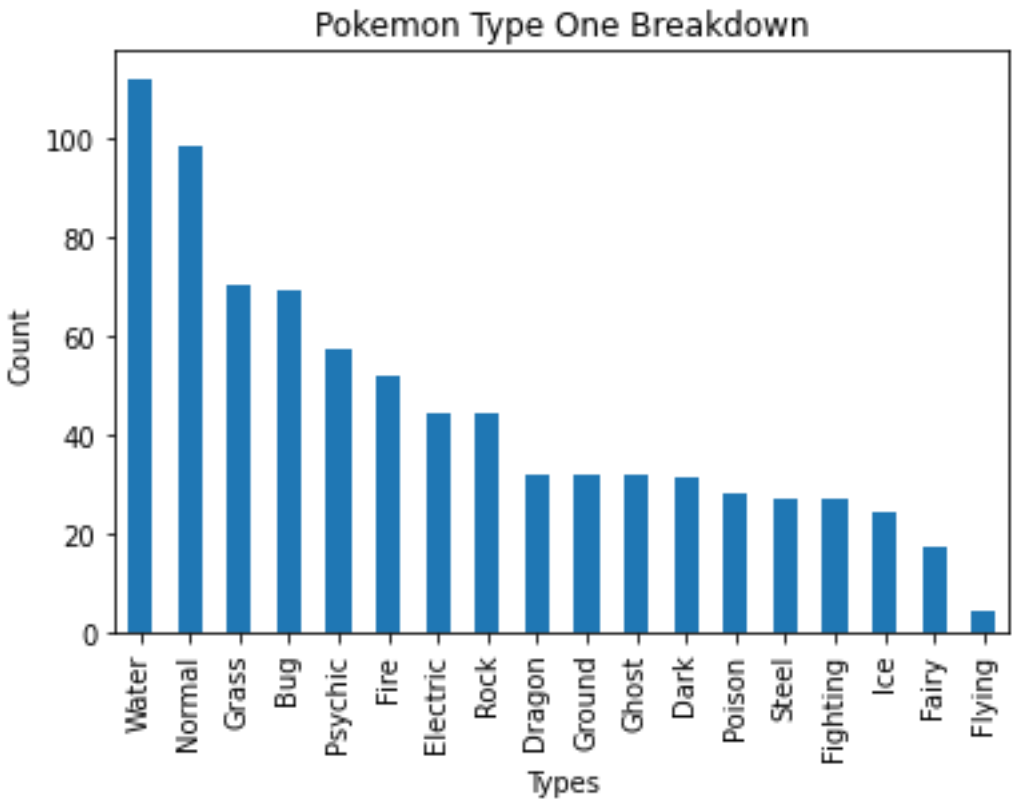
The final dataset is the test data which is labeled tests.csv. This file will be used with the model once it is trained to predict the winner of each battle.

Methods

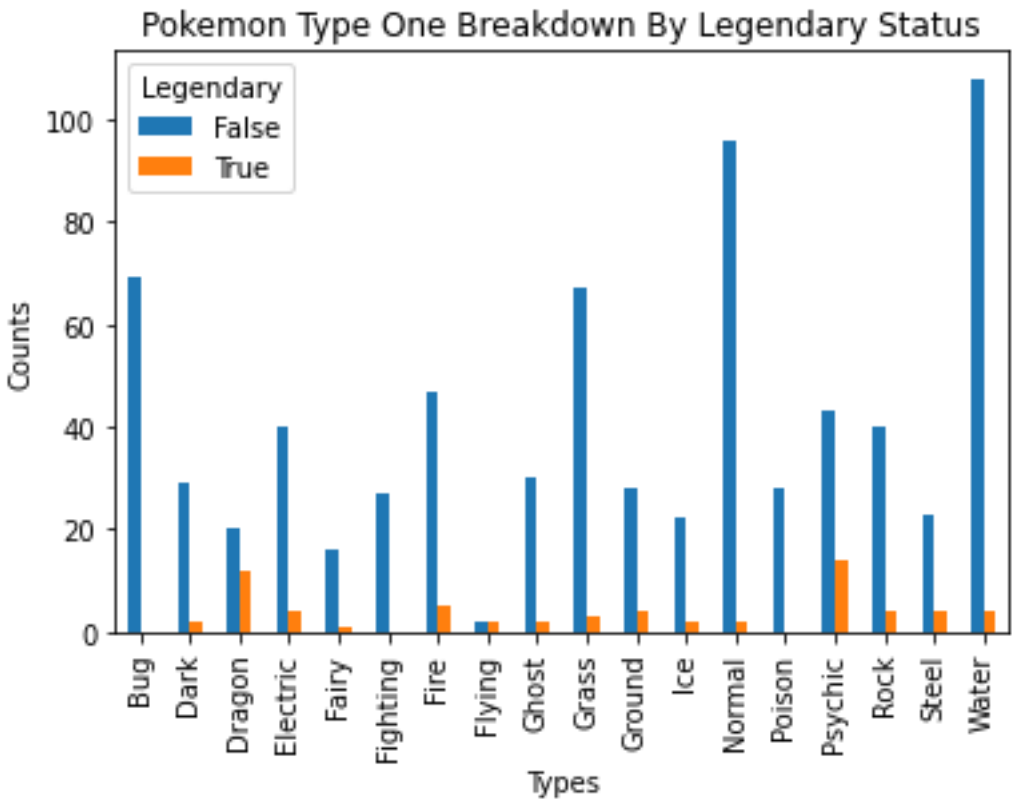
Three different methods were utilized for this project. The first method was multilinear regression model. The second method was a random forest model. Finally, the last method was the XGBoost model.

Analysis

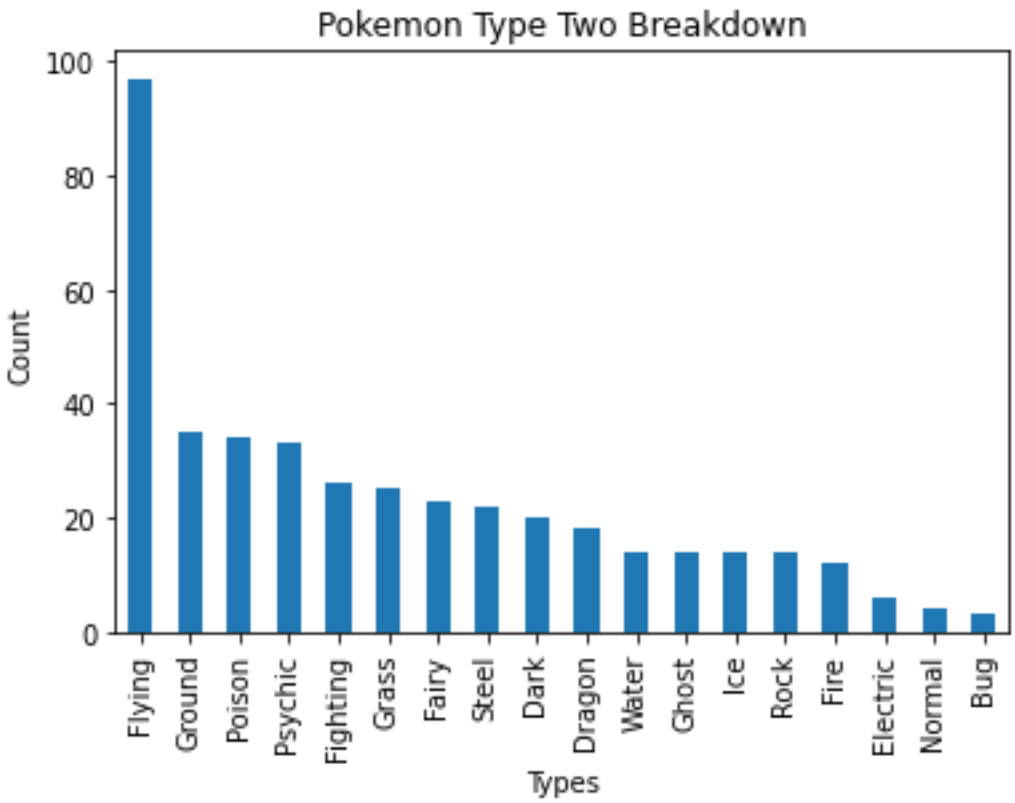
In the exploratory data analysis (EDA) phase, there were many trends that were identified. In the Pokémon characteristics dataset, the difference types are not balanced between Type One and Type Two. In Type One, the top three types are Water, Normal, and Grass. The bottom three types are Flying, Fairy, and Ice. This imbalance could mean that stronger Pokémon are skewed toward types are occur more often. Below is the breakdown of the different types:



Furthermore, out of the six different generations, the Water type is in the top three types in five of those generations. However, when it comes to Legendary Pokémon, which tend to be stronger than non-legendary Pokémon, the Water type is not in the top three types. Below is the breakdown of type one types in Legendary Pokémon.



The Type Two breakdown is the opposite of the breakdown of Type One. The top three Type Two types are Flying, Ground, and Poison. This reverse breakdown could be the way that The Pokémon Company balances the game with the different types. Below is the full breakdown of Pokémon Type Two types.



In the recorded battles dataset, there are a few more trends identified. First, out of 800 Pokémon, sixteen of those Pokémon didn't fight in a battle. Additionally, out of the 784 Pokémon that did battle, only one Pokémon never won a single battle. Shuckle was the one Pokémon that didn't win any battles. Of note, this Pokémon has huge defense and special defense, 230, but doesn't have a high attack or special attack stat, 10.

Looking further into the win percentages of these recorded battles, the types that had the most wins in Type One were Flying, Dragon, and Electric. The types that had the most wins in Type Two were Fighting, Flying, and Normal. Additionally, Legendary Pokémon were more likely to win their battles than non-Legendary Pokémon.

The last trend of note in the record battles dataset is that the top fifteen Pokémon to win battles were almost all alternate forms of the Pokémon, specifically the Mega form dominated the

top fifteen Pokémon. In the bottom fifteen Pokémon, majority of those Pokémon were the first stage of the evolution. This makes sense as Pokémon tend to gain better stats as they evolve into different stages.

Out of the three models that were utilized for this project, XGBoost has proven to be the most useful. The XGBoost model received a r2 score of .71 compared to .68 and .51 for the Random Forest model and Linear Regression Model respectively.

Conclusion

In conclusion, the best model is the XGBoost model. While it isn't as accurate as it could be, it can still produce a faster timeline for professional players to find the best meta in the game. With additional time and opinions from professional players to determine the best features, the model can be improved.

Assumptions

One of the assumptions for this project is that the custom algorithm that created the recorded Pokémon battles is as close to the real battles as possible. Additionally, another assumption is that The Pokémon Company doesn't drastically change how the game is played. Any drastic changes to the game could break the model. Fortunately, it has been over 25 years and the game hasn't been drastically changed.

Limitations

The major limitation of the current model is that it is outdated. There are currently 1015 Pokémon compared to the 800 in the current Pokémon characteristics dataset.

Challenges

The biggest challenge for the project was trying to get the models to have a better r2 score. The feature selection was hard to determine.

Future Uses / Additional Applications

There are many future uses or additional applications that this model can be shaped for. For starters, the current dataset is specifically for the video game stats. The model can be changed to work for Pokémon TCG. The difference would be the Pokémon characteristics would be for the Pokémon TCG instead of the Pokémon video game as well as needing new battle data.

Additionally, this concept can be expanded to other video games that are within the same genre as Pokémon. If the Pokémon TCG model works well, the concept can be expanded to other trading card games as well like Yu Gi Oh, Magic The Gathering, and Digimon.

Recommendations

The recommendation moving forward is to find real recorded battles to use with the model. From there, the model can be pushed to a few select professional players to test out to ensure the model works correctly. At that point, the model can be opened to all players of Pokémon tournaments.

Implementation Plan

There are two different implementation plans that can be built out for the deployment of the models. First, the goal of the model is to give some players an advantage in discovering the meta of the game. For that reason, the first implementation plan would be to hide the model behind a subscription fee on a website. Players can pay to use the website to input their ideas of different Pokémon they may want in their team and see which Pokémon they win against.

However, the second implementation plan is more in line with the community values of the Pokémon community. This implementation plan would be like the first one except it is free to all players. While this may eliminate the advantage of finding the new initial meta faster, it could still affect the game. Players may be able to find the next strategy to beat the current meta faster. This could help the game because it means the meta wouldn't stagnate as it can sometimes.

Ethical Assessment

The first major ethical consideration that needs to be addressed is the fact that the Pokémon battle dataset comes from a custom algorithm and not real recorded Pokémon battles. This means that the model isn't being trained on "real" data, which in turn can cause predictions to be incorrect.

The best way to address this ethical consideration is to communicate that the model is a proof of concept. Since it has worked very well with simulated data, the next step would be to collect real data and train the model once again. Additionally, it should be recommended that players test out the predictions through their own testing.

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Questions

1) What makes Mega Pokémon so powerful compared to normal forms of Pokémon?
    a. Mega evolution into a Mega Pokémon provides that Pokémon with new abilities and stats. Every Mega Pokémon, except for one, will have an increase in base stats by 100 compared to its base form.
2) Are there any of features of Pokémon that could be added to the characteristics?
    a. There are two different features of Pokémon that could be added. The first is the ability of a Pokémon. A Pokémon may have up to one ability, which is a passive effect in battle. The other feature is Nature. Nature will boost one of the non-health point stats of the Pokémon by 10% and decrease another by 10%.
3) Are there additional items to battles that may affect the outcome of said battle?
    a. Yes, there are items that Pokémon can hold that will be triggered in battle. In addition, there are other items that can heal or revive Pokémon.
4) Are there special tournament rules that may affect the outcome of a battle?
    a. At any point, if a player breaks the rules, they could be penalized which may affect the outcome of a battle.
5) What features were most important to predicting the outcome of a battle?
    a. Attack and Speed
6) What features were least important to predicting the outcome of a battle?
    a. Defense
7) Does Shuckle's evolved forms do well in battles?
    a. Shuckle doesn't have an evolution form yet.
8) What is the average attack stat of the Pokémon that win over 90% of their battles?
    a. 109.24
9) What is the average defense stat of the Pokémon that win over 90% of their battles?
    a. 74.44
10) Is each generation of Pokémon balanced across all the Pokémon?
    a. Generally speaking, every generation is balanced across all Pokémon.