A Big Data Analysis of Pokémon Battling

A Thesis

Presented to

The Established Interdisciplinary Committee for Mathematics and Economics

Reed College

In Partial Fulfillment

of the Requirements for the Degree

Bachelor of Arts

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May 2017

Approved for the Committee

(Mathematics and Economics)

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Acknowledgements

I wanted to thank everyone working for Pokémon Showdown for the opportunity to work with a rich dataset that continues to pose challenges well beyond the realm of Pokémon battling.

Table of Contents

List of Tables

List of Figures

Abstract

This study attempts to answer a question pertaining to game strategies: is it beneficial to pursue strategies that do not immediately damage an opponent? Furthermore: is the impact of these strategies dependent upon when the moves are used? These questions are tested using data from a popular online Pokémon battling game, Pokémon Showdown. This study tests whether the use of specific moves positively contribute to a player's likelihood of winning a battle. This study finds surprisingly uniform results. Evidence shows that when players utilize moves that do not directly damage their opponent, they have a higher likelihood of winning a game. Additionally, moves considered complementary to these strategies positively impact a player's likelihood of winning a game more than only utilizing moves that do not directly damage their opponent. Furthermore, this study provides evidence that these effects are more pronounced when a player pursues these strategies earlier in a game, defined as within the first five turns of a game.

Dedication

This work is dedicated to all past, current and future members of The Rocking Chair.

Chapter 1

Pokémon Showdown and The Pokémon World

1.1 Introduction

The world of Pokémon began in 1996 with the pair of games Pokémon Red and Green. For Western audiences, the latter game would become known as Pokémon Blue. These two games introduced a unique system turn-based game that continues to define the franchise of Pokémon games. Numerous other games have attempted to copy the Pokémon battling format, but none have been able to equal its widespread appeal and dedicated player base. With each successive iteration, new items, Pokémon types, and of course new species of Pokémon are added to the Pokémon lexicon. As a result, the world of Pokémon has continued to grow and evolve into one of the largest video games franchises to date. The most recent iteration of Pokémon games, Pokémon Sun and Moon, have continued Pokémon's commercial and historical trend of turning profits while adding layers to an already complex system of battling.

Since 2011 the program Pokémon Showdown has offered a simplified version of

Pokémon games. This simplified version allows players to exclusively battle one another, replicating the most recent iteration of the Pokémon games in the process. This has allowed players to hone and test their Pokémon battling skills through the years. With well-over 10,000 daily registered users and counting, this program has become the go-to program to test and practice Pokémon battling strategies in the ultimate pursuit of becoming the very best that no one ever was.

However, before any formal analysis of Pokémon battling is discussed, the battling system of Pokémon must be rigorously detailed for laymen and theorists alike.

First and foremost, each Pokémon battle occurs exclusively between two players. Each of the two players has a team composed of six Pokémon. For the purposes of analysis, teams with duplicate Pokémon will not be considered, namely because such teams are not allowed in ranked battles (and not included in the data considered in this study). As such, teams are composed of six distinct Pokémon. As a point of note, only battles in the 'Anything Goes' category allow any Pokémon to be used, including duplicate species within a player's team. Furthermore, depending on the battle format the team of six Pokémon is either randomly assigned or dictated by the player. The format being considered in this study, Overused (abbreviated OU), provides an example format where players dictate their team composition. A number of different battle formats exist beyond OU and Anything Goes, including Random Battles (abbreviated Randbats), giving a cumulative total of 59 different battle formats at the time this study was conducted.

Regardless of the battle format, each turn each player simultaneously makes a decision for the Pokémon they have on the field. The decisions are then executed. The order of play is decided by a comparison of the moves each player selects. Priority is given first to priority moves and then, if neither player selected a priority move for the turn, by a comparative assessment of the speeds of the two Pokémon. If each player uses

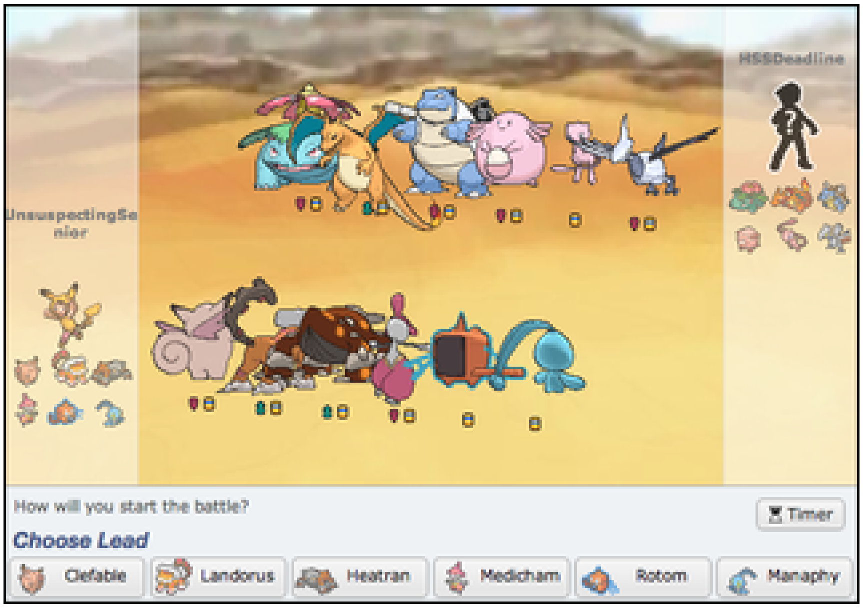

Figure 1.1: The Beginning of a Battle

a move with the same priority, then the comparative assessment of speed is used to determine who attacks first.

The potential moves Pokémon are able to execute have a wide variety of effects (the finer details are discussed in Chapter 2). Regardless of the damage or effects of the executed moves, once a player's Pokémon loses all of its health, an event referred to as fainting, the player must switch into another Pokémon. If a player has no other Pokémon to switch into, the battle ends. As would be expected, the player whose Pokémon have all fainted loses the battle. Conversely, the player who eliminates all of their opponent's Pokémon wins.

Furthermore, each Pokémon has at most four possible moves to chose from during any turn of a battle. Whenever a player has at least two Pokémon that have not fainted, they have additional choice to switch into another Pokémon. Doing so counts as the player's action for the turn. As a result, players almost always have five different choices to make each turn.

There are still a number of other details that are relevant to consider beyond those already mentioned. Namely, while some information is fixed during the battle, including the opposing players team composition, some variables of interest are case-specific. These include what moves an opposing Pokémon has already used, and consequently revealed, along with a given Pokémon's held item, its ability, and a slew of other variables. However, similar to the different type of moves a Pokémon can choose from, these points will be detailed in the Chapter 2.

That being said, to formally analyze Pokémon battling the game itself must be formally denoted in game theoretic terms. This will aid in both describing the game and in highlighting its complexity. With this in mind, it bears noting that there are only two outcomes to any battle: One player wins and the other loses. Because of this, Pokémon battling is by definition a zero-sum game. However, it is important to note that there some distinctions between how a player can win or lose a game. Though the game ends when all of the Pokémon on one team have fainted, any player has the choice to forfeit the game any time before this occurs. Thus, the two ways to win or lose a battle are either by forfeiture or by having all of their Pokémon faint; this latter outcome is referred to as a full game. Additionally, there is the potential for a game to result in a draw. However, draws result in a neutral payoff as neither player raises or lowers their ranking after a draw. By contrast, when a player wins a battle their rank increases, while conversely if they lose their rank decreases.

1.2 Game Theory of Pokémon

Within the scope of game theoretic terms, it is vital to note that each player is able to see all past decisions made over the course of a battle. Additionally, battles only last a finite number of turns. Speaking to the former point, players are able to recall not only their past decisions but also those of their opponent, including how much damage was done by a specific move during a given turn. In the format analyzed in this study, players even know the composition of their opponent's team from the very beginning of the match, as shown in Figure 1.1. More generally however, this information is available at any time during the battle, making Pokémon battling a perfect recall game. Furthermore, as each game is composed of a sequence of turns, Pokémon battling is a sequential game.

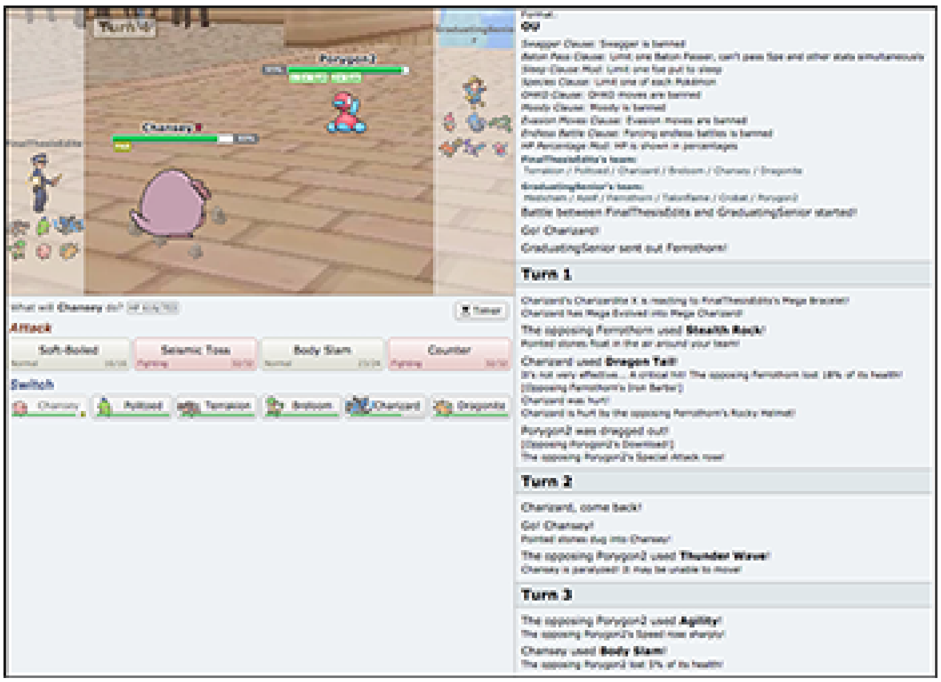

Figure 1.2: Information Available After Two Turns

The points pertaining to the availability information allude to a unique trait of Pokémon battling that further details the type of game Pokémon battling is: An incomplete information game. Though the extent of incompleteness is format specific, each player is given limited information about the opposing player's team at the beginning of the battle. After each turn, players learn not only the different moves each opposing Pokémon has, but also their abilities, held items, and sometimes what other Pokémon compose the opposing team (if the format is Randbats). Generally speaking, there is almost always new information revealed each turn.

Taken together, Pokémon battling is a special case of a sequential, zero-sum two-player game with incomplete information and perfect recall. As Pokémon battling lends itself to a discussion of imperfect information, it is all the more vital to consider the role of decision making within the context of sequential games. However, it is vital to note that this study will not do so using expansive game trees or comparison of payoff tables. Namely this is done due to computational limitations, which were ever present throughout the research process.

However, the extent to which player strategies are revealed from information is an open topic of discussion, both in the post-estimation analysis if this study and current game theory literature. Naturally, the analysis of such a topic relies upon at least one a priori assumption, namely that player strategies are revealed by their past decisions. However, whether player strategies are rational and consistent is another matter entirely, and one that is not explicitly addressed. Nonetheless, it is important to note that incorporating such information into players own decision-making complicates analysis and is a central topic in analyzing player strategies specific to Pokémon battling.

Game theoretic considerations aside, there are also important computational notes to detail. In this regard, initial computations and analysis focused on the distribution of turn lengths, i.e. the length of games played when one player forfeited or had all of their Pokémon faint and the corresponding distribution of game lengths. These initial computations revealed that there were a number of battles that lasted less than one turn, which were then pruned from later models and analysis. Following this, moves are categorized by their type, specifically whether a specific move is a “setup” move or may be considered complementary to a “setup” move. These two types of moves are considered in greater detail in Chapter 2. Following this, I gauge the effectiveness of using specific moves on the empirical probability that using such move corresponded to a winning outcome.

Overall I explore the decision-making process involved in Pokémon battling, specifically moves that are considered patient and moves considered complementary to patient moves. By incorporating tenants of behavioral economics and game theory, I hope to highlight not only the empirical probabilities of winning associated with specific move sets, but also analyze how and why such events may contribute to a higher lilkihood of winning a battle. More specifically, I will continue the recent trend of 'Big Data' analysis to explore macro trends in player's decision making processes. In doing so I hope to answer two main questions: Does utilizing patient strategies positively influence the likelihood of winning a Pokémon battle, and are these findings generalizable across specifications? In the context of Pokémon battling, is a player is better off by deciding to use one type of entry hazard over another and are these findings generalizable across when in the battle the moves were used?

1.3 Literature Review

Scant rigorous or academic research has been conducted within the scope of Pokémon-related topics. The most frequent publications have typically focused on Pokémon as a cultural phenomena or have been official strategy guides for the various Pokémon games published by Nintendo affiliates. Importantly, these strategy guides do not detail Pokémon battling strategies, although they do detail the numerous Pokémon species, items, and moves available in each game. Thus, strategy guides provide a foundational background about the Pokémon, moves, and other basic information but do not provide clear formulations of general battling strategies. Some recently publications have come close though.

Academic papers that have focused Pokémon battling have developed and analyzed algorithms to simulate Pokémon battling and play against human players in the program Pokémon Showdown. The first paper of this kind gives a rudimentary background on Pokémon battling and focuses explicitly on 1v1 battle simulations (Gildardo 2013). However, in a detailed analysis of one particular one-on-one scenario the author is single minded and only focuses on one-on-one Pokémon battles. Furthermore, Gildardo (2013) does not consider other potential variants on Pokémon abilities or item pairings. In this regard, Gildardo's article does not go into great detail on the many variants of Pokémon battling, as highlighted by the exclusion of teams of Pokémon.

This point notwithstanding, since Gildardo (2013) there has been one other notable publication that focuses on Pokémon battling. This publication focuses on the creation and analysis of algorithms within the context of Pokémon battling; the article additionally goes into greater detail on battling strategies while incorporating comparative analysis of the different algorithms used to play against human opponents (Ho et al. 2016). Though Ho et al. 2016 focused on what is currently a previous iteration of Pokémon Showdown, the iteration of Pokémon Showdown is fundamentally the same as that of the data used in this study. Nonetheless, the paper does have some shortcomings as well. Namely, the algorithms used would never select a move whose type would be not very effective against the opponent's fielded Pokémon. This point will be detailed later, but needless to say such a decision is not always the preferred one, especially if the moves being used are entry hazards.

Furthermore, on the subject of different versions of Pokémon Showdown, relevant documentation of the past iterations of Pokémon Showdown are available at the program's website. The website for Pokémon Showdown provides a hub for information ranging from Pokémon battling basics to specific battle format descriptions. Similar to all information mentioned thus far, replays and ladder ranking are available publically. Furthermore, the site provides Pokémon usage statistics and a damage calculator for aspiring Pokémon battlers.

As noted previously, game theory vernacular has not entered into discussions on Pokémon battling strategies, at least in any formal setting. Applying such concepts to the context of Pokémon battling offers a formal foundation to discuss strategies and test hypotheses. In this regard, there are three main areas of game theory that intersect in the analysis of Pokémon battling. These three areas of interest include the interpretation of Pokémon battling as a zero sum game, the role of incomplete information, and the implications of Pokémon battling as a non-cooperative game. These three topics actively influence the decision-making process associated with Pokémon battling.

A central factor involved in the decision making process as it relates to game theory is the role of information, specifically how players incorporate information revealed each turn into their strategies. As information is revealed each turn, including the four moves an opposing Pokémon has, each Pokémon's ability, held item, and a number of other factors, it is vital for players to determine if the information they just received in a given turn is relevant. Simply put, players need to decide if the information they just received provides any insight into their opponent's strategy. Overall, this speaks to Pokémon being a game with imperfect information. As such, it is not possible to apply Zermelo's theorem, though its negation provides insight as to the possible existence of a weakly dominating strategy (Schwalbe et al. 2001). The method to empirically test such strategies is by tracking the use of specific moves, in this study entry hazards and complementary moves, and testing whether players that used specified move sets won more games than players that did not utilize such move sets.

This being said, concepts from game theory are not the only relevant ideas for analyzing Pokémon battling. In the context of exploring the frequency of players switching Pokémon will necessarily invoke concepts from behavioral economics as well as game theory. Relevant to the field of behavioral economics, the concept of “keeping doors open” is an interesting concept to explore in regards to Pokémon battling. The concept of “keeping doors” open is explored in Chapter 6 of Ariely’s work Predictably Irrational, giving an idea of what the expected results may be in the context of Pokémon battling. Specifically, as players may decide to preemptively switch Pokémon in the hopes of having that Pokémon later in the battle, they may arrive at suboptimal outcomes. Via application of Ariely’s empirical results, players may prefer to keep certain Pokémon available until the end of the battle, even if doing so incurs costs and/or reduces their chances of winning. Though this concept is not explicitly tested, this study tackles a similar though contrapositive point by empirically testing whether moves that do not necessarily incur damage the turn they are used result in a higher likelihood of winning a battle. By doing so, this study tests whether players are better off when they only use damaging moves, or specifically non-entry hazard moves. However, before tackling how to formulate a testable hypothesis, some of the finer details of Pokémon battling must be highlighted.

Chapter 2

Game Description

The data used is a compilation of battle logs taken from the Pokémon Showdown servers. The data spans the entirety of December 25th, 2015 to December 27th of the same year. No battle logs are incomplete, i.e. none of the daily data entries are empty, though some are excluded for their turn length. Each battle effectively serves as two observations in the dataset, one observation for each player. Overall, there were no dramatic overhauls done to the OU format or the overall Pokémon battling system used in this study. However, some adjustments have been made since the time covered in this study and will be highlighted in the analysis portion of the study.

Furthermore, only ranked games are included in the dataset. Ranked battles are battles that count towards a players global ranking in Pokémon Showdown. For each battle, players stand to gain or lose ranking points depending on whether they win or lose the battle.

As noted in the Literature Review, a number of different Pokémon databases redirect users to the host site of Pokémon Showdown. The name is this site is Smogon University. The website for Smogon University offers a wide variety of resources, similar to those found at the Pokémon Showdown website. Most importantly the

Smogon forums are a prominent site for discussion of Pokémon battling strategies, along with detailing what Pokémon compose specific battle formats.

2.1 Pokémon Battling Basics

The Pokémon battle starts with one Pokémon being sent out from each player's team. For the purposes of the data used in this study, one Pokémon is sent out from each opponent. This totals two Pokémon being active at any given point in the battle. Following this, each Pokémon has 4 moves to choose from, along with the option to switch to a different Pokémon (when applicable). After both players make a decision, the moves are weighted for priority and speed to determine the order of play. If both players decide not to switch, one Pokémon will attack the other, after which the next Pokémon will do the same if it has not fainted. After each move has been executed the turn ends and the process is repeated. When one of the Pokémon faints, the player whose Pokémon fainted will be prompted to select another Pokémon from the bench. The first player to lose all of their Pokémon loses the battle.

However, before the nitty gritty details are explained it is important to make a concession. The entirety of the Pokémon battling system, even that used in the data, is not included in this analysis. The number of cases that deviate from the rules detailed below are either not included in the competitive format, or are generally inconsequential to the scenarios and strategies considered in this study.

2.1.1 Battle Formats

The data used for this study includes only one battling format: OU. The two most frequently used formats are OU and Randbats respectively, at least as indicated from preliminary fact-finding. Both formats have teams of six Pokémon and only allow one

Pokémon to be out at any given time. While both battle formats are subsets of what are known as single battles, only OU will be highlighted in greater detail.

The OU format includes team composition. By including team composition, players are able to decide what Pokémon to include on their team, the moves of each Pokémon, and other parameters such as held items and abilities. However, there are still some restrictions placed on players. Specific species of Pokémon are barred from use, notably Pokémon classified as “Ubers”. Uber Pokémon include a large number of legendary Pokémon, along with some mega-Pokémon. Additionally, certain “hidden” abilities are restricted, limiting the possible Pokémon abilities a specific species may use for a given format.

Format-Specific Pokémon

There are a number of other battle formats that are not analyzed in the current study. Nonetheless, a brief overview of these is germane in relation to the different Pokémon explicitly studied. The order of ‘tiers’ is as follows: Uber, OU, BL, UU, NU, and Limbo, where BL stands for Borderline, UU stands for Under Used, and NU stands for Never Used. A number of species in tiers below OU are used in the battles observed in the dataset. Just as Ubers allows use of Pokémon that are from OU battles, so too do the other tiers of Pokémon battling, i.e. UU allows use of NU Pokémon. However, there are a number of Pokémon that ‘belong’ to a given tier, insomuch as they are considered staple Pokémon of that format. To reduce the list of 600+ Pokémon, the roster of Pokémon considered in this study are the 415 Pokémon that are considered staple Pokémon for the tiers spanning OU to Limbo. This effectively reduces the number of Pokémon that are considered competitive, along with doing so in a manner that is systematic to the players of the games considered. That being said, it’s important to delve into some Pokémon-specific topics that are general to the battling system, not necessarily related to specific battle formats.

2.1.2 Pokémon Types

Typeage is a unique characteristic to Pokémon battling. Currently there are 18 distinct types. These include normal, fire, water, electric, grass, ice, fighting, poison, ground, flying, psychic, bug, rock, ghost, dragon, dark, steel, and fairy. Both moves and Pokémon are given a type attribute, though moves are only one type. Additionally, while a move may only be one of the 18 types, a Pokémon can be at most two different types at once.

However, some of these combinations are not found in Pokémon. From the initially possible 171 Pokémon type combinations, 18 choose 2 plus 18 monotypes, there are actually only 133 types that a player may encounter or chose from (as 38 type combinations had not yet been used during 2015). It is also worth noting that some Pokémon are able to change type during a battle, but for the purposes of analysis these Pokémon will be considered special cases and will be briefly touched upon in Chapters 3 and 4.

The typeage of each Pokémon influence not only the potential weaknesses of each Pokémon, but also the amount of damage that type-specific does. Each Pokémon has at least one and at most two types. If a Pokémon uses a damaging move whose type corresponds to the typeage of the Pokémon that used it, that Pokémon gets a same type attack bonus, abbreviated as a “stab” bonus. This causes the move to do 50% more damage, potentially 100% if the Pokémon also has the ability Adaptability.

2.1.3 Pokémon Attributes

Generally, there are a number of factors that are specific to each Pokémon. Some of these factors are considered static, meaning that they do not and cannot change over the course of the battle. These types of factors are defined as “Fixed” attributes. However, some factors such as the base statistics of a Pokémon are fixed at the beginning of the battle and *can* change over the course of a battle. There are also a number of factors that are able to generally change over the course of a battle. Such factors, by constrast, are defined as “Variable” attributes. The terminology is largely taken from Ho et al. (2016) for ease of appropriability. The attributes are detailed in the order given.

2.1.4 Pokémon Fixed Attributes

Fixed attributes include the typeage of a Pokémon, the four moves each Pokémon specie has, the item the Pokémon holds, the Pokémon’s ability, the level of the Pokémon, and the Pokémon’s base statistics. However, there are exceptions to the rules for each of these attributes except for the level of the Pokémon. Every fixed attribute and its respective exception(s) will be considered in the order listed.

First and foremost is the typeage of a Pokémon, detailed previously. One scenario where a Pokémon can change its type is specific to a Pokémon’s ability. Both Protean and Color Change are abilities that are able to change a friendly Pokémon’s typeage. The former ability changes the Pokémon Kecleon’s type to that of the move that affected (or hit) it, whereas the latter ability turns its type into the typeage of the move that just was just used by the Pokémon Greninja. These two abilities are specific to Kecleon and Greninja. Furthermore, there are moves that able to make the opponents Pokémon into a water, grass, or ghost Pokémon (on top of their previous typeage) if they use the moves Soak, Forest's Curse, and Treat-Or-Treat respectively.

Each Pokémon's set moves are also fixed during a battle. The exception to this occurs when a Pokémon runs out of power points, denoted as PP, for all of its four moves. Every move has a set limit to the number of times it can be used, though the number of times a move can be used varies across the set of moves. At this point the Pokémon is only able to use the move struggle. The move is a physical attack that will also the damage the user of the move. The struggle is real.

Pokémon are able to hold one item at the beginning of the match. Pokémon may also lose their held item either by being hit by the move Knock-off, which knocks the opponent's Pokémon's item off, or by using their held item. Some held items are able to be consumed for a one-time effect. This scenario includes the consumption of berries, which offer a variety of different effects to the Pokémon holding it. For example, if a Pokémon is given a status condition, a condition detailed in the following section, from an opposing Pokémon while holding a Lum berry, the berry will be consumed and the Pokémon's status condition will be cured. The player does not actually control when the berry will be consumed, as the consumption of the berry is dependent upon what moves an opponent uses on said Pokémon. This example highlights an important characteristic of some held-items: some items may only be used once and are discarded after their initial use.

One of the most important items that a Pokémon can hold is an item that allows the Pokémon to mega-evolve. When a Pokémon mega-evolves, it increases its base statistics, changing its ability, and even changing the typeage of the Pokémon. This special case of item holding is a focus of this study. Additionally, only one mega-Pokémon is allowed on a team at once, making variables that account for the different mega-Pokémon independent by nature. An example of a Pokémon that has undergone mega-evolution is shown in Figure 2.1.

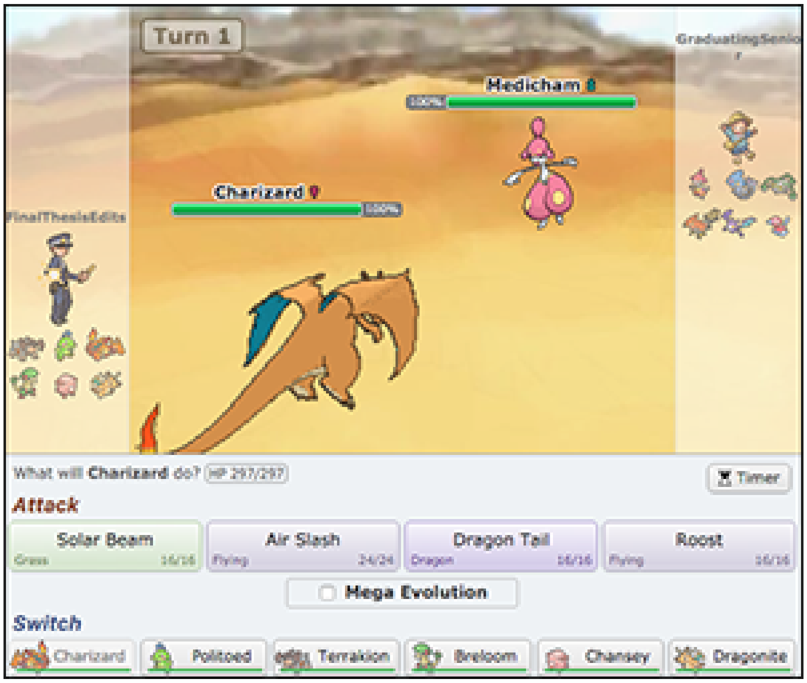

Figure 2.1: First Turn Options

Similar to items, a Pokémon can only have one ability at a time. However, by contrast to a Pokémon's held item a Pokémon always has an ability. A Pokémon cannot have no ability. Nonetheless, Pokémon may have their ability swapped with another Pokémon's. This scenario only occurs a Pokémon makes physical contact with Yamask or Cofagrigus, at which point its ability is swapped with Mummy. Mummy will only change a physically-attacking Pokémon's ability; it has no other effect.

The level of a Pokémon varies between one and one-hundred. The higher the level, the better the base statistics for a given Pokémon, specifically in comparison to lower levels of that given Pokémon. Base statistics are divided into six categories. These categories include (baseline) health, attack, special attack, defense, special defense, and speed. There is further nuance with the inclusion of Pokémon natures and Individual Values, or IVs. These factors influence the base statistics of each Pokémon. However due to the sheer number of trivial combinations of IV spreads and nature choices, these two factors will not be a pivotal aspect to the framework and analysis of Pokémon battling. Nonetheless, the volatility of these baseline stats will be considered as a variable attribute.

2.1.5 Pokémon Variable Attributes

Variable Attributes include boosts or reductions to a Pokémon's base statistics, the status condition of the Pokémon, the volatile status of the Pokémon, the current health of the Pokémon, and whether the Pokémon is currently active.

The former-most attribute directly influences how effective an active Pokémon is able to be in battle. Pokémon are able to learn and use moves that can boost their own status or ones that reduce their opponents. However, these moves are only able to influence a Pokémon's attack, special attack, defense, special defense, or speed. For example, the move Swords Dance raises its users attack status so long as the Pokémon remains active. The move may be used multiple times, but is only effective until it boosts or lowers its target's baseline stat by 3 or 1/3 respectively.

Status conditions are composed of a variety of statuses. Pokémon that suffer a status condition are either burned, frozen, paralyzed, poisoned, badly poisoned, or have fallen asleep. A Pokémon can only suffer from one status condition at a time, although a Pokémon can suffer from multiple status conditions during a battle if it overcomes the first status condition.

Each of these statuses is distinct, though there are similarities between being poisoned or badly poisoned. A Pokémon that is just poisoned will take damage equal to 1/8th of its maximum HP at the end of each turn. By comparison a Pokémon that is badly poisoned takes n/16th of its maximum HP at the end of the nth turn the Pokémon has been badly poisoned. A Pokémon that is poison-type or steel-type is unable to be poisoned, and if a Pokémon has the ability Poison Heal it is healed 1/8th of its maximum HP at the end of each turn.

If a Pokémon is burned it takes 1/8th of its maximum HP in damage at the end of the turn. This has recently been changed to 1/16th of its maximum HP per turn, but this is just a passing point of note. Regardless of the amount of damage done to the burned Pokémon, the burned Pokémon's physical attacks do half damage. The exception to this rule is if the affected Pokémon has the ability Guts. Additionally, a fire-type Pokémon cannot be burned.

In a similar vein to being burned, a paralyzed Pokémon has its speed reduced to 1/4th of its base speed. Furthermore, a Pokémon that is paralyzed has a 1/4 chance of not being able to move during its move. This event is referred to as being "fully paralyzed". Furthermore, electric-type Pokémon are unable to be paralyzed, and if a Pokémon has the ability Lightning Rod it's special attack is boosted by 1.5 its base level. Additionally, ground-type Pokémon cannot be paralyzed, just as they are not affected by electric-type moves.

A Pokémon that has fallen asleep is unable to use its moves except for the moves Snore and Sleep Talk. A Pokémon falls asleep for one to five turns. However, if a Pokémon purposely puts itself to sleep using the move rest, it is asleep for exactly two turns. If a Pokémon has either of the abilities Vital Spirit or Insomnia, it cannot be put to sleep.

Lastly, there is the status condition of being frozen. Similar to previous typed statuses, ice type Pokémon are immune to becoming frozen, as are Pokémon with the ability Magma Armor. There is no set number of turns that a Pokémon can be frozen, but if a frozen Pokémon is hit by fire-type moves or the move scald is thaws out and is no longer frozen.

Volatile statuses are similar to status conditions, except that the volatile status will be negated by switching out the affected Pokémon. Similar to status conditions, a

Pokémon can only be affected by one volatile status at a time. Another important point to consider is that a Pokémon can suffer from both a volatile status *and* a status condition, i.e. a Pokémon can be both paralyzed and confused. That being said, the most common form of volatile status is confusion. A Pokémon is confused for one to four turns, during which time the confused Pokémon has a 50% chance to hurt itself instead of executing its move for the turn. A Pokémon may also be encored, meaning that it has to use the same move it just moved for 3 turns.

Only currently active Pokémon are able to execute moves. Likewise, only active Pokémon may be damaged. Beyond this there is not anything else to detail in regards to the current health and activity of a Pokémon that is exclusive to variable attributes.

2.1.6 Environmental Variables ("Patient Moves")

There is one more class category to detail that is relevant to the analysis of Pokémon battling. This category is the role of the environment in battling and is a central focus of this study's analysis of Pokémon battling. Though related to the different types of moves and abilities a Pokémon has, including both fixed and variable attributes, the environment is not specific to any one move, ability, or specie of Pokémon and as such must be highlighted separately from the previous attributions.

The most prominent environmental variables to consider are what are referred to as "set-up" moves. These moves include Stealth Rock, Spikes, Toxic Spikes, Sticky Web, Light Screen, and Reflect. The latter two are different from the rest of the set-up moves in that they only last five turns, eight if the user was holding Light Clay when the move was used. When these moves are employed, the active Pokémon's special defense and defense are raised by one stage -or is increased by 1.5- respectively between Light Screen and Reflect. However, Light Screen and Reflect are not considered in the model specifications because they have a limited effect.

The former four set-up moves are a focal point of analysis and are in a category of moves known as entry hazard moves. Entry hazards are considered patient moves in this study due to their indirect effects, namely that they do not directly damage opposing Pokémon the turn they are used. These moves are of particular note because they can last for the entirety of a given battle. Once these moves are used, only certain moves or switches are able to eliminate them. Generally, using the move rapid spin or defog will eliminate the entry hazards, along with causing other effects. However, if a Pokémon uses defog, both their and their opponent's entry hazards will be eliminated. By contrast, rapid spin only eliminates entry hazards affecting the users team.

However, both defog and rapid spin are not included in the analysis. Instead, moves that are seen as supplemental to entry hazards are considered. The four moves that are considered supplemental to entry hazards include Dragon Tail, Circle Throw, Whirlwind, and Roar. The latter two moves only switch out the opposing player's Pokémon, whereas the former two moves will damage the opponent's active Pokémon and then switch them out. All of these moves force the opponent's active Pokémon to switch into another random Pokémon on their team. This process necessarily requires the opponent to have another Pokémon to switch into. However, as players always know how many more Pokémon are available for both their and their opponent's teams, an underlying assumption is that these moves are not used trivially, i.e. when the opposing player only has one Pokémon left on their team.

Moreover, there is still the matter of detailing entry hazards. To begin with, both Stealth Rock and Sticky Web can only be used once during a battle, at least until previous uses of either are eliminated by use of moves such as Rapid Spin. However, each of these entry hazards have different effects. Specific to the latter, Pokémon that enter the field after Sticky Web is employed have their speed lowered by one stage, or 2/3rd their baseline level. This only applied to grounded, or non-flying, Pokémon however. By contrast, Stealth Rock will damage any Pokémon that enters the field after it is used. The amount of damage done to the Pokémon depends on the type effectiveness of rock-type moves, as Stealth Rock is a rock-type move. In ascending order, Stealth Rock will do 3.125%, 6.25%, 12.5%, 25%, and 50% of the affected Pokémon's maximum health according to type effectiveness. This corresponds to 0.25x, 0.5x, 1x, 2x, and 4x damage respectively.

Similar to Sticky Web, spikes only affect non-flying type Pokémon. However, spikes will inflict damage to Pokémon that switch in instead of afflicting them with a volatile status condition. The amount of damage is dependent upon the number of layers of spikes active on the field. Spikes may be applied a maximum of three times. One layer of spikes will damage the opposing Pokémon by 1/8th of its maximum HP, while two layers will deal 1/6th, and three layers will do 1/4th of the opposing Pokémon's maximum health.

Lastly is toxic spikes that, just like spikes and sticky web, only affect grounded Pokémon with a status condition. However, toxic spikes are able to be applied two times. The first layer of toxic spikes will poison opposing Pokémon that switch in, while two layers of toxic spikes will badly poison Pokémon that switch in (that is, if the Pokémon that switches in is able to be poisoned). Just like most other entry hazards, toxic spikes only affects grounded Pokémon.

Chapter 3

Empirical Results

3.1 Model Specification

As Pokémon battles included in the dataset have only two outcomes, we may estimate the probability of winning using a standard probit model. There are minor differences between using a logit and probit models, so the decision to use a probit model is simply a personal choice. Additionally, each battle effectively serves as two separate observations, or one observation for each player. As for the models, let Y denote the outcome of any battle for a given player, where Y takes the value of 0 if the player loses the battle and 1 if the player wins. To identify whether specific moves and Pokémon choices differentially impact the probability of winning a game, we define the dependent variable of the models used as $f^{-1}(P(Y = 1))$, where f^{-1} is the probit function.

Surprisingly, there were no draws in the dataset, perhaps alluding to a small likelihood for a draw to occur. Nonetheless, to address the question of whether any entry hazards positively impact a player's likelihood of winning, we develop a number of different probit models.

We begin with whether a specific move was used by a player in a battle. Let the set of all entry hazards be denoted S_1 and let the set of all complementary moves be denoted S_2. We define the full set of moves as S where S is defined as follows: S ={Stealth Rock, Spikes, Toxic Spikes, Sticky Web, Dragon Tail, Roar, Circle Throw, Whirlwind}.
Furthermore, S_1={Stealth Rock, Spikes, Toxic Spikes, Sticky Web}. By construction, $S_2 = S/S_1$, as by definition $S = S_1 \cup S_2$. This distinction is important for later model specifications. Additionally, for simplicity let the elements of the set S, S_1 and S_2 be defined by the acronym of each move, i.e. Stealth Rock is denoted SR.

Then, define a count variable on the set S that takes the value of how many times a specified move is used in a battle. As an example, let M_{SR} be the variable that counts the number of times Stealth Rock was used in a battle. The variable takes value 1 when Stealth Rock is used once in a battle and 0 if it was not used at all by a player in a battle. We define the variables M_S , M_{TS} , M_{SW} , M_{DT} , M_R , M_{CT} , and M_W similarly. These variables will be interacted with one another in later models, but they also provide strategic value singularly. For this reasons they will be included in the preliminary model, which is given by:

$(1) : f^{-1}(P(Y = 1)) = \alpha + \sum_{i \in S} \beta_i(M_i)$

This study focuses particularly on the interactions and repeated use of the specified moves. Interactions in particular focus on Stealth Rock, because it directly damages Pokémon that switch in and because it can only be used once, making interaction terms easier to interpret than interactions with moves that can be used multiple times. Nonetheless, the squared term for Stealth Rock is included in the second model to test whether reapplying the move is an effective battling strategy. This includes cases were the battle environment is cleared. That being said, the model for including the squared term of moves is given as follows:

$(2) : f^{-1}(P(Y = 1)) = \alpha + \sum_{i \in S} \beta_i(M_i) + \sum_{i \in S} \iota_i(M_i)^2$

We then include interactions between different moves and their squared terms. The corresponding model (3) is given by:

$(3) : f^{-1}(P(Y = 1)) = \alpha + \sum_{i \in S} \beta_i(M_i) + \sum_{i \in S} \iota_i(M_i)^2 + \sum_{j \in S/SR} \theta_j(M_{SR} \times M_j) + \sum_{j \in S/SR} \lambda_j(M_{SR} \times (M_j)^2)$

These models have not yet included the vast variety of species composing teams. Before defining these models, we must first define the set of all competitive Pokémon and mega-Pokémon. To begin with the former, let the set of all competitive Pokémon be denoted P, where $P = \{Abomasnow, ..., Zygarde\}$. The full list of Pokémon and their frequency of use in the dataset is included in the Appendix. There are 415 elements in the set P and 39 in the set G, where G is the set of all Mega-Pokémon allowed in the OU format. Let P_1 be the first element in the set of Pokémon P. Let the numerical index apply for all 415 Pokémon. Similarly define G_1 as the first mega-Pokémon in the set G. Then we index the set of 39 mega-Pokémon numerically.

Following the indexing of the set of Pokémon and mega-Pokémon, we construct a number of variables that act as indicators for whether the Pokémon was used in a battle by a player. Hence, we define the variable for using the first Pokémon on the competitive roster as PU_1, which takes the value 1 if the first Pokémon on the competitive roster is used and 0 otherwise. This is applied iteratively across all 415 competitive Pokémon. Furthermore, let GU_1 denote the variable indicating if the first mega-Pokémon in the mega-Pokémon roster is used in a battle. This construction is applied to the set of 415 Pokémon and 39 mega-Pokémon.

Before examining the interactions between a team's composition of Pokémon and specific moves, there needs to be a formal model that accounts for the impact of a Pokémon choice on the likelihood of winning a battle. Respective to the variables outlined previously, we have:

$(4): f^{-1}(P(Y=1)) = \alpha + \sum_{i \in S} \beta_i(M_i) + \sum_{i \in S} \iota_i(M_i)^2 + \sum_{j \in S/SR} \theta_j(M_{SR} \times M_j) + \sum_{j \in S/SR} \lambda_j(M_{SR} \times (M_j)^2) + \sum_{l \in P} \gamma_l(PU_l)$

Thirty nine different Pokémon can turn into mega-Pokémon however. To test whether a Pokémon negatively or positively impacts the probability of winning, the next model specification includes mega-Pokémon within the roster of competitive Pokémon. The model is given by:

$(5): f^{-1}(P(Y=1)) = \alpha + \sum_{i \in S} \beta_i(M_i) + \sum_{i \in S} \iota_i(M_i)^2 + \sum_{j \in S/SR} \theta_j(M_{SR} \times M_j) + \sum_{j \in S/SR} \lambda_j(M_{SR} \times (M_j)^2) + \sum_{l \in P} \gamma_l(PU_l) + \sum_{k \in G} \tau_k(GU_k)$

After these five model specifications, the combination of models (1) through (3) are given in the following section, and later on the combination of models (3) through (5). These are included to compare the coefficients, or the impact on the z-score, from a specific move, Pokémon, and Mega-Pokémon. By doing so, the coefficients track whether a player won or lost more often when utilizing a move their opponent did not use.

After the first five models, the moves will be categorized by whether entry hazards were used ‘early’ or ‘late’ in a battle. The distinction between when early and late is distinguished by a specific line in the battle log, as each battle log is composed of a number of lines of code corresponding to the moves and outcomes of each turn. Though the cutoff point is determined arbitrarily, the cutoff effectively corresponds to whether a move was used before or after the 5th turn of a battle. With this in mind, we simply create two indicator variables that denote whether a specified entry hazard is used by or after the 5th turn of a battle. Similar to the use of acronyms used previously, let E denote the early indicator variable. E takes value 1 if the move is used before or during the 5th turn of a battle and 0 otherwise. Similarly let L denote the indicator variable for whether a move is used after the 5th turn of a battle. L takes value 1 if the move is used after the 5th turn and 0 otherwise. We then construct the interaction between the time and move indicator variables, denoted $(E \times I)_i$ for the indicator of using the ith move early in a battle. We similarly construct $L \times I)_i$ for the indicator variable for the ith move being used late in a battle. Compared to models (1) through (5), models (6) through (10) do not count the number of times a specified move was used in a battle, at least for entry hazards. Instead, models (6) through (10) use an indicator variable for whether an entry hazard was used.

Thus we define an indicator variable on the set S to takes the value 1 if a specified move is used in a battle and 0 otherwise. As an example, let I_{SR} be the variable that indicates whether Stealth Rock was used in a battle. The variable takes value 1 when Stealth Rock is used and 0 if it was not used by a player in a battle. We define the variables I_S , I_{TS} , and I_{SW} similarly, but we do not construct indicator variables for the complementary moves. Thus, for model (6), we have the simple model differentiating between whether an entry hazard was used before or after the 5th turn, given by:

$(6) : f^{-1}(P(Y = 1)) = \alpha + \sum_{i \in S_1} \beta_i (E \times I_) i + \sum_{i \in S_1} \nu_i (L \times I)_i + \sum_{i \in S_2} \delta_i (M_i)$

Similar to model (2), we include the squared term for count variables. However, this only includes moves complementary to the use of entry hazards. Including the squared terms for complementary moves yields the following model specification:

$(7) : f^{-1}(P(Y = 1)) = \alpha + \sum_{i \in S_1} \beta_i (E \times I)_i + \sum_{i \in S_1} \nu_i (L \times I)_i + \sum_{i \in S_2} \delta_i (M_i) + \sum_{i \in S_2} \delta_i (M_i) + \sum_{i \in S_2} \iota_i (M_i)^2$

Following this, model (8) includes the interaction between the two different indicators for Stealth Rock and other move variables. The interactions include both the squared terms for the complementary moves and the interaction between different entry hazard indicator variables. Model (8) is thus given as follows:

$(8) : f^{-1}(P(Y = 1)) = \alpha + \sum_{i \in S_1} \beta_i (E \times I)_i + \sum_{i \in S_1} \nu_i (L \times I)_i + \sum_{i \in S_2} \delta_i (M_i) +$

$\sum_{i\in S_2}\iota_i(M_i)^2+\sum_{j\in S_2}\theta_j((E\times I)_{SR}\times M_j)+\sum_{j\in S_2}\mu_j((L\times I)_{SR}\times M_j)+\sum_{j\in S_2}\lambda_j((E\times I)_{SR}\times(M_j)^2)+\sum_{j\in S_2}\epsilon_j((L\times I)_{SR}\times(M_j)^2)+\sum_{j\in S_1/SR}\chi_j((E\times I)_{SR}\times(E\times I)_j)+\sum_{j\in S_1/SR}\xi_j((E\times I)_{SR}\times(L\times I)_j)+\sum_{j\in S_1/SR}\psi_j((L\times I)_{SR}\times(E\times I)_j)+\sum_{j\in S_1/SR}\omega_j((L\times I)_{SR}\times(L\times I)_j)$

Following this, we follow a similar construction of models (4) and (5) for models (9) and (10) respectively. Thus, the final two models are given as follows:

$(9): f^{-1}(P(Y=1))=\alpha+\sum_{i\in S_1}\beta_i(E\times I)_i+\sum_{i\in S_1}\nu_i(L\times I)_i+\sum_{i\in S_2}\delta_i(M_i)+\sum_{i\in S_2}\iota_i(M_i)^2+\sum_{j\in S_2}\theta_j((E\times I)_{SR}\times M_j)+\sum_{j\in S_2}\mu_j((L\times I)_{SR}\times M_j)+\sum_{j\in S_2}\lambda_j((E\times I)_{SR}\times(M_j)^2)+\sum_{j\in S_2}\epsilon_j((L\times I)_{SR}\times(M_j)^2)+\sum_{j\in S_1/SR}\chi_j((E\times I)_{SR}\times(E\times I)_j)+\sum_{j\in S_1/SR}\xi_j((E\times I)_{SR}\times(L\times I)_j)+\sum_{j\in S_1/SR}\psi_j((L\times I)_{SR}\times(E\times I)_j)+\sum_{j\in S_1/SR}\omega_j((L\times I)_{SR}\times(L\times I)_j)+\sum_{l\in P}\gamma_l(PU_l)$

Following this model, we include the full roster of mega-Pokémon. This gives the final model, given as follows:

$(10): f^{-1}(P(Y=1))=\alpha+\sum_{i\in S_1}\beta_i(E\times I)_i+\sum_{i\in S_1}\nu_i(L\times I)_i+\sum_{i\in S_2}\delta_i(M_i)+\sum_{i\in S_2}\iota_i(M_i)^2+\sum_{j\in S_2}\theta_j((E\times I)_{SR}\times M_j)+\sum_{j\in S_2}\mu_j((L\times I)_{SR}\times M_j)+\sum_{j\in S_2}\lambda_j((E\times I)_{SR}\times(M_j)^2)+\sum_{j\in S_2}\epsilon_j((L\times I)_{SR}\times(M_j)^2)+\sum_{j\in S_1/SR}\chi_j((E\times I)_{SR}\times(E\times I)_j)+\sum_{j\in S_1/SR}\xi_j((E\times I)_{SR}\times(L\times I)_j)+\sum_{j\in S_1/SR}\psi_j((L\times I)_{SR}\times(E\times I)_j)+\sum_{j\in S_1/SR}\omega_j((L\times I)_{SR}\times(L\times I)_j)+\sum_{l\in P}\gamma_l(PU_l)+\sum_{k\in G}\tau_k(GU_k)$

3.2 Interpretation of Basic Statistics

The summary of the variables used in the models are a preliminary point of interest. While the count variables, game length, player rank, and a number of other variables are included in this section in Tables 3.1 and 3.2, both lack any details on team composition. For the sake of brevity, the full list of summary statistics for Pokémon and Mega-Pokémon is found in the Appendix.

That being said, the average game length is sixteen turns. However, the standard deviation is nearly 12 turns with a maximum value of 171 and a minimum value of 0. This statistic is influenced by a number of battles that last 0 turns. As games lasting zero turns do not provide any meaningful information about player's decisions, they are excluded from all regressions used henceforth. Furthermore, in regards to ranking, most observations are within the range of 1000 to 1280 elo, as the mean rank is 1154 with a standard deviation of 128.7 elo points. Elo points are a value indicating player rank, where new players start with rank 1000 and increase in rank as they win more battles. Bearing this in mind, given that the highest rank observed in the data is 1815, there is a noticeable divide between the highest ranking games and those within one standard deviation to the mean. This is an interesting feature of the data. However, since all regressions used in this study are composed of the entire set of battles of length greater than one, it there may be differences between high and low rank battles. Though this difference is not explored in great detail, it is nonetheless an interesting point to note when bearing in mind the following information.

Table 3.1: Non-Pokémon Summary Table

Statistic	Mean	St. Dev.	Min	Max
Outcome	0.500	0.500	0	1
Rank	1,153.582	128.706	1,000.000	1,836.428
Battle_Length	16.433	12.018	0	289

Table 3.2 reports the mean and standard deviation of each of the move variables, including the indicator variables for whether an entry hazard was used before or after the 5th turn of a battle. Specific to entry hazards, the data indicates that players utilize entry hazards within the first five turns more than they utilize entry hazards after the first five turns. Furthermore, players often utilize the entry hazards Stealth Rock and Spikes more than Toxic Spikes and Sticky Web. In regards to the complementary moves, players utilize Dragon Tail the most and Circle Throw the least. This is

interesting, as both moves typeage allows an opposing Pokémon to not be affected by these moves. Additionally, all complementary moves are used less frequently than Stealth Rock and Spikes, though all complementary moves except Circle Throw are utilized more frequently than either Sticky Web or Toxic Spikes.

Though the summary statistics of Pokémon usage are reported in the Appendix, some features are worth highlighting. In regards to Pokémon and Mega-Pokémon statistics, nearly half of the most frequently used Pokémon, that of Alakazam, Banette, and Garchomp, are able to mega-evolve. Within this group of three, Garchomp may be considered an outlier, as both Mega-Alakazam and Mega-Banette were banned from the OU format following the year the data was gathered. Besides this standout feature of the Pokémon and mega-Pokémon summary statistics, the remaining frequently used Pokémon are considered staples of the OU format: Clefable, Talonflame, and Heatran. Of the total six most frequently used Pokémon, half have the ability to use the move Stealth Rock. This is important to bear in mind when considering the preliminary models. Though specifically in regards to the Mega-evolution usage statistics, the four most frequently used mega-Pokémon are mega-Venusaur, mega-Scizor, and both mega-evolutions of Charizard. This is surprising, given that Alakazam, Banette, and Garchomp are frequently used but their mega-evolutions are not. This may be evidence to the fact that players prefer to use these Pokémon's regular form in lieu of their mega-evolutions.

Another interesting point shown in the summary statistics is that Mega-Pokémon are not always utilized by players. This is shown by the fact that the cumulative sum of the mean of all Mega-Pokémon variables does not add up to one. Given this discrepancy, it would be an interesting extension to this study to test whether utilizing any Mega-Pokémon positively impacts the likelihood of a player winning a battle. Nonetheless, a more general stand-out feature of the Pokémon summary statistics is that players did not utilize Pokémon that were banned in the following years any more than other Pokémon.

Table 3.2: Non-Pokémon Summary Table

Statistic	Mean	St. Dev.
Circle_Throw	0.001	0.052
Stealth_Rock	0.389	0.642
Spikes	0.127	0.552
Toxic_Spikes	0.023	0.199
Sticky_Web	0.019	0.149
Dragon_Tail	0.055	0.349
Roar	0.027	0.255
Whirlwind	0.035	0.334
Early_Stealth_Rock	0.222	0.416
Late_Stealth_Rock	0.139	0.346
Early_Spikes	0.040	0.195
Late_Spikes	0.038	0.191
Early_Toxic_Spikes	0.011	0.104
Late_Toxic_Spikes	0.007	0.082
Early_Sticky_Web	0.015	0.121
Late_Sticky_Web	0.004	0.061

3.3 Interpretation of Basic Regressions

Before delving into an analysis of specific variables and their coefficients, it is important make a preliminary note. Since there is dependence between the rows of the dataset used to make the probit models, the standard errors are underestimated. This dependence occurs because each battle is used as two observations, one for each player of a battle. While the standard errors reported in the following models are underestimated because of this dependence, the estimators are nonetheless not biased.

This being said, due to the primary focus on the move Stealth Rock in the models constructed, the term is interacted with the seven other specified moves in model

(3). This includes the seven moves squared terms. Tables 3.3 to 3.6 indicate that the model's accuracy is improved by the inclusion of move interactions and squared terms. However, the constant of models (1) through (3) bear some note. The constant for all three model specifications is negative, indicating that players have a greater likelihood of losing a battle when they don't utilize entry hazards or moves considered complementary to entry hazards.

Additionally, the coefficients of each entry hazard vary between positive and negative across specifications, notably for the move Sticky Web. Sticky Web is of particular interest and is detailed in later specifications. Considering complementary moves, the move Dragon Tail has a negative impact on player's likelihood of winning a battle. However, surprisingly the interaction between Stealth Rock and Dragon Tail is positive and statistically significant. Not only this, but the squared term for Dragon Tail is also positive. Taken in conjunction, this provides some preliminary evidence that entry hazards and complementary moves are an effective Pokémon battling strategy. The same results are found for the other damaging complementary move: Circle Throw. While the squared interaction with Stealth Rock is negative, the combination of Stealth Rock and Circle Throw is positive. Interestingly, these results only apply to complementary moves that also damage Pokémon. Though this point is elaborated upon in detail in later specifications, this is overall an indication that supplementary moves can positively impact a player's win outcome if they also damage opposing Pokémon when they force a Pokémon to switch out.

Taken literally, utilizing either Stealth Rock, Stealth Rock and Dragon Tail, or Stealth Rock and Circle Throw will increase the likelihood of winning a battle. However, this interpretation should be taken with some hesistance, as the magnitude of using just Stealth Rock is greater than the interaction between Dragon Tail and Stealth Rock. Furthermore, Circle Throw is used infrequently in the dataset, which could explain both why the interaction between Stealth Rock and Circle Throw being 0.29 and not statistically significant. Not only this, the coefficeints report the how a change in the predictor will change the z-score, holding all other factors constant and in comparison to any players that did not utilize that move. This means that the comparison group for using Stealth Rock and a complementary move is any player that did not utilize both strategies. Furthermore, the two other moves Whirlwind and Roar are negative and statistically insignificant in later model specifications. Thus, Tables 3.3 to 3.6 indicate some preliminary evidence that entry hazards not only influence the probability of winning a battle, but that they do so to considerably different degrees.

Following the preliminary models of (1) through (3) in Table 3.3 to 3.6, let us consider models (6) through (8). The corresponding tables are Table 3.7 through 3.12. One of the first outstanding features of models (6) through (8) is the difference across time specifications. Namely, all coefficients attached to “Early” variables are more positive than their “Late” counterparts. Beyond this point, the signage of each move indicator variable is similar to those discussed previously for models (1) through (3). Stealth Rock is positive across both model and time specifications, lending further credence to the view that the move positively impacts a player’s likelihood of winning a battle. Furthermore, the interactions between “Early” Stealth Rock and damaging complementary moves are positive. This point does not include interactions between “Late” Stealth Rock and the squared terms for the damaging complementary moves. Generally, these models further support the use of Stealth Rock and complementary moves, but typically only when Stealth Rock or other entry hazards are utilized within the first five turns of a battle.

Table 3.3: Models 1-3 Basic Move Set

	Dependent variable:		
	Outcome		
	(1)	(2)	(3)
Stealth_Rock	0.153^{***}	0.192^{***}	0.200^{***}
	(0.003)	(0.004)	(0.004)
Spikes	0.034^{***}	0.043^{***}	0.063^{***}
	(0.004)	(0.005)	(0.006)
Toxic_Spikes	-0.071^{***}	-0.107^{***}	-0.090^{***}
	(0.011)	(0.021)	(0.028)
Sticky_Web	-0.009	0.008	0.043^{*}
	(0.013)	(0.018)	(0.023)
Dragon_Tail	-0.005	-0.014	-0.045^{***}
	(0.006)	(0.009)	(0.014)
Roar	-0.019^{**}	-0.037^{***}	-0.031
	(0.008)	(0.012)	(0.020)
Whirlwind	0.010^{*}	0.004	0.017
	(0.006)	(0.008)	(0.012)
Circle_Throw	0.004	0.007	-0.055
	(0.037)	(0.073)	(0.082)
Constant	-0.061^{***}	-0.071^{***}	-0.074^{***}
	(0.002)	(0.002)	(0.002)
Observations	424,894	424,894	424,894
Log Likelihood	$-293,162.400$	$-292,921.600$	$-292,863.000$
Akaike Inf. Crit.	586,342.900	585,877.300	585,787.900

Note: *p<0.1; **p<0.05; ***p<0.01
Normal Standard Errors Shown in Parenthesis .

Table 3.4: Models 1-3 Cont.: Squared Move Set.

	Dependent variable:		
	Outcome		
	(1)	(2)	(3)
Circle_Throw2		-0.0004	0.006
		(0.011)	(0.012)
Stealth_Rock2		-0.009^{***}	-0.009^{***}
		(0.0005)	(0.001)
Spikes2		-0.002^{***}	-0.004^{***}
		(0.001)	(0.001)
Toxic_Spikes2		0.014^{*}	0.008
		(0.008)	(0.012)
Sticky_Web2		-0.011	-0.004
		(0.008)	(0.011)
Dragon_Tail2		0.001	0.006^{**}
		(0.002)	(0.003)
Roar2		0.003	0.005
		(0.002)	(0.004)
Whirlwind2		0.0004	0.001
		(0.001)	(0.001)
Observations	424,894	424,894	424,894
Log Likelihood	$-293,162.400$	$-292,921.600$	$-292,863.000$
Akaike Inf. Crit.	586,342.900	585,877.300	585,787.900
Note:			*p<0.1; **p<0.05; ***p<0.01
			Normal Standard Errors Shown in Parenthesis .

Table 3.5: Models 1-3 Cont.: Squared Move Set with Interactions

	Dependent variable:		
	Outcome		
	(1)	(2)	(3)
Stealth_Rock_Spikes2			0.001^{***}
			(0.0002)
Stealth_Rock_Sticky_Web2			0.007^{**}
			(0.003)
Stealth_Rock_Toxic_Spikes2			0.015
			(0.010)
Stealth_Rock_Whirlwind2			−0.00001
			(0.001)
Stealth_Rock_Dragon_Tail2			-0.005^{***}
			(0.002)
Stealth_Rock_Roar2			−0.001
			(0.002)
Stealth_Rock_Circle_Throw2			−0.041
			(0.037)
Observations	424,894	424,894	424,894
Log Likelihood	−293,162.400	−292,921.600	−292,863.000
Akaike Inf. Crit.	586,342.900	585,877.300	585,787.900
Note:	*p<0.1; **p<0.05; ***p<0.01		
	Normal Standard Errors Shown in Parenthesis .		

Table 3.6: Models 1-3 Cont.: Move Set Interactions

	Dependent variable:		
	Outcome		
	(1)	(2)	(3)
Stealth_Rock_Spikes			-0.023^{***}
			(0.004)
Stealth_Rock_Sticky_Web			-0.101^{***}
			(0.022)
Stealth_Rock_Toxic_Spikes			-0.051^{*}
			(0.028)
Stealth_Rock_Whirlwind			-0.011
			(0.007)
Stealth_Rock_Dragon_Tail			0.030^{***}
			(0.011)
Stealth_Rock_Roar			-0.009
			(0.014)
Stealth_Rock_Circle_Throw			0.290
			(0.186)
Observations	424,894	424,894	424,894
Log Likelihood	−293,162.400	−292,921.600	−292,863.000
Akaike Inf. Crit.	586,342.900	585,877.300	585,787.900
Note:			*p<0.1; **p<0.05; ***p<0.01
			Normal Standard Errors Shown in Parenthesis .

Table 3.7: Models 6-8 Basic Move Set

	Dependent variable:		
	Outcome		
	(1)	(2)	(3)
Early_Stealth_Rock	0.247***	0.247***	0.250***
	(0.005)	(0.005)	(0.005)
Late_Stealth_Rock	0.184***	0.185***	0.190***
	(0.006)	(0.006)	(0.006)
Early_Spikes	0.051***	0.051***	0.070***
	(0.012)	(0.012)	(0.017)
Late_Spikes	0.087***	0.088***	0.122***
	(0.012)	(0.012)	(0.018)
Early_Toxic_Spikes	−0.094***	−0.094***	−0.075***
	(0.022)	(0.022)	(0.029)
Late_Toxic_Spikes	−0.160***	−0.160***	−0.183***
	(0.026)	(0.026)	(0.037)
Early_Sticky_Web	0.016	0.016	0.067***
	(0.016)	(0.016)	(0.020)
Late_Sticky_Web	−0.096***	−0.097***	−0.038
	(0.032)	(0.032)	(0.044)
Observations	424,894	424,894	424,894
Log Likelihood	−292,600.000	−292,597.000	−292,536.500
Akaike Inf. Crit.	585,225.900	585,228.000	585,163.000
Note:			*p<0.1; **p<0.05; ***p<0.01
			Normal Standard Errors Shown in Parenthesis .

Table 3.8: Models 6-8 Cont.: Complementary Moves and Early Entry Hazards

	Dependent variable:		
	Outcome		
	(1)	(2)	(3)
Circle_Throw2		-0.0003	0.005
		(0.011)	(0.012)
Dragon_Tail2		0.003	0.017^{***}
		(0.002)	(0.004)
Roar2		0.003^{*}	0.007
		(0.002)	(0.006)
Whirlwind2		0.001	-0.00002
		(0.001)	(0.002)
Constant	-0.082^{***}	-0.082^{***}	-0.083^{***}
	(0.002)	(0.002)	(0.002)
Observations	424,894	424,894	424,894
Log Likelihood	$-292{,}600.000$	$-292{,}597.000$	$-292{,}536.500$
Akaike Inf. Crit.	585,225.900	585,228.000	585,163.000
Note:	*p<0.1; **p<0.05; ***p<0.01		
	Normal Standard Errors Shown in Parenthesis .		

Table 3.9: Models 6-8 Cont.: Complementary Move Set and Early Entry Hazards

	Dependent variable:		
	Outcome		
	(1)	(2)	(3)
Early_Stealth_RockXWhirlwind2			0.002
			(0.002)
Early_Stealth_RockXDragon_Tail2			-0.015^{***}
			(0.005)
Early_Stealth_RockXRoar2			-0.0003
			(0.006)
Early_Stealth_RockXCircle_Throw2			0.046
			(0.071)
Late_Stealth_RockXWhirlwind2			0.001
			(0.002)
Late_Stealth_RockXDragon_Tail2			-0.019^{***}
			(0.005)
Late_Stealth_RockXRoar2			-0.006
			(0.006)
Late_Stealth_RockXCircle_Throw2			-0.231^{**}
			(0.107)
Observations	424,894	424,894	424,894
Log Likelihood	$-292{,}600.000$	$-292{,}597.000$	$-292{,}536.500$
Akaike Inf. Crit.	585,225.900	585,228.000	585,163.000
Note:			*p<0.1; **p<0.05; ***p<0.01
			Normal Standard Errors Shown in Parenthesis .

Table 3.10: Models 6-8 Cont.: Early and Late Move Interactions Cont.

	Dependent variable:		
	Outcome		
	(1)	(2)	(3)
Early_Stealth_RockXEarly_Spikes			-0.029
			(0.025)
Early_Stealth_RockXLate_Spikes			-0.048^{*}
			(0.025)
Early_Stealth_RockXEarly_Sticky_Web			-0.121^{***}
			(0.035)
Early_Stealth_RockXLate_Sticky_Web			-0.219^{***}
			(0.077)
Early_Stealth_RockXEarly_Toxic_Spikes			-0.093^{*}
			(0.049)
Early_Stealth_RockXLate_Toxic_Spikes			0.010
			(0.059)
Early_Stealth_RockXWhirlwind			-0.037^{*}
			(0.019)
Early_Stealth_RockXDragon_Tail			0.119^{***}
			(0.021)
Observations	424,894	424,894	424,894
Log Likelihood	$-292,600.000$	$-292,597.000$	$-292,536.500$
Akaike Inf. Crit.	585,225.900	585,228.000	585,163.000
Note:			*p<0.1; **p<0.05; ***p<0.01
			Normal Standard Errors Shown in Parenthesis .

Table 3.11: Models 6-8 Cont.: Early and Late Move Interactions Cont.

	Dependent variable:		
	Outcome		
	(1)	(2)	(3)
Early_Stealth_RockXRoar			0.021
			(0.029)
Early_Stealth_RockXCircle_Throw			−0.019
			(0.263)
Late_Stealth_RockXEarly_Spikes			−0.043
			(0.030)
Late_Stealth_RockXLate_Spikes			−0.047*
			(0.025)
Late_Stealth_RockXEarly_Sticky_Web			−0.133**
			(0.055)
Late_Stealth_RockXLate_Sticky_Web			−0.006
			(0.071)
Late_Stealth_RockXEarly_Toxic_Spikes			0.014
			(0.062)
Late_Stealth_RockXLate_Toxic_Spikes			0.052
			(0.060)
Observations	424,894	424,894	424,894
Log Likelihood	−292,600.000	−292,597.000	−292,536.500
Akaike Inf. Crit.	585,225.900	585,228.000	585,163.000

Note: *p<0.1; **p<0.05; ***p<0.01
Normal Standard Errors Shown in Parenthesis .

Table 3.12: Models 6-8 Cont.: Complementary Moves and Late Interactions Cont.

	Dependent variable:		
	Outcome		
	(1)	(2)	(3)
Dragon_Tail	-0.015^{***}	-0.024^{***}	-0.115^{***}
	(0.006)	(0.009)	(0.017)
Roar	-0.024^{***}	-0.040^{***}	-0.063^{**}
	(0.008)	(0.012)	(0.026)
Whirlwind	0.010^{*}	0.005	0.035^{**}
	(0.006)	(0.008)	(0.016)
Circle_Throw	0.005	0.006	-0.040
	(0.037)	(0.073)	(0.082)
Late_Stealth_RockXWhirlwind			-0.033^{*}
			(0.018)
Late_Stealth_RockXDragon_Tail			0.093^{***}
			(0.022)
Late_Stealth_RockXRoar			0.024
			(0.029)
Late_Stealth_RockXCircle_Throw			0.998^{**}
			(0.450)
Observations	424,894	424,894	424,894
Log Likelihood	$-292{,}600.000$	$-292{,}597.000$	$-292{,}536.500$
Akaike Inf. Crit.	585,225.900	585,228.000	585,163.000
Note:			*p<0.1; **p<0.05; ***p<0.01
			Normal Standard Errors Shown in Parenthesis .

3.4 Interpretation of Final Models

Including both the Pokémon and mega-Pokémon rosters adds some additional nuance to the models. The results of models (3) through (5) are highlighted in tables 3.13 to 3.16. Similar to the previous regressions, the coefficients of the Pokémon and mega-Pokémon are not shown for the sake of space. Additionally, even if these regressions included coefficients for using a specific Pokémon or mega-Pokémon, it is important to note that the coefficients assigned to each variable do not directly report marginal impact of Pokémon or mega-Pokémon choice. Additionally, these variables noticeably provide scant prescriptive use, as they do not include the 415 choose 6 different teams possible under the specifications explored. Furthermore, even the 415 choose 6 different Pokémon teams possible does not include the different mega-Pokémon options. Needless to say, Tables 3.13 through 3.16 are included to provide a test of robustness for the move variables specifically, along with highlighting the improved accuracy of later model specifications.

Specifically, Table 3.13 in particular corroborates the statistical significance and signage of the Stealth Rock variable. However, the coefficient of the Stealth Rock variable decreases as additional parameters are included. Furthermore, the values of the Akaike Information Criterion (AIC) and log likelihood indicate that the model improves in quality when including the Pokémon roster. The model also improves even more when both Pokémon and Mega-Pokémon are included into the mix. This is not surprising given the role that Pokémon play in a battle and the sheer number of parameters composing the roster of Pokémon and Mega-Pokémon.

Tables 3.13 through 3.16 also highlight an additional point, as the coefficients assigned to both Spikes and Sticky Web are positive and are statistically significant in later specifications. Though both Spikes and Stealth Rock remain statistically significant across specifications, Toxic Spikes is only positive and not statistically significant in model (5). Interestingly, Spikes and Toxic Spikes can be applied to a battle environment more than once. Given that the squared terms of all entry hazards are negative, the results indicate that entry hazards are best utilized only once, regardless of the specific entry hazard being used. However, there are some caveats to this point, specifically in using Stealth Rock with multiple applications of Spikes or Toxic Spikes. In both of these instances, the initial interaction coefficient is negative but the squared interaction coefficient is both positive and statistically significant. Furthermore, the combination of damaging complementary moves with Stealth Rock again continues to be positive, though the statistical insignificance of Circle Throw continues across model specifications.

Tables 3.17 through 3.22 further detail the inclusion of the Pokémon and mega-Pokémon roster. The tables correspond to the regressions of models (8) through (10). Similar to the analysis of models (6) through (8), specifications for "Early" entry hazards are more positive than their "Late" counterparts. In fact, the only "Early" entry hazard that is not statistically significant in the final specification is Toxic Spikes, though the signage of this variable changes from negative to positive in models (9) and (10) respectively. This is especially interesting, as the results closely mirror those found in models (3) through (5). Furthermore, while the count variable of Dragon Tail is negative, its squared term is positive. Taken in conjunction with the fact that the interaction between "Early" and "Late" Stealth Rock with Dragon Tail is positive and statistically significant, there is further evidence that utilizing both entry hazards and damaging complementary moves positively impacts a player's likelihood of winning a battle.

There is one particularly noticeable caveat to the information presented thus far. It is specific to the use of Stealth Rock and Circle Throw. This point is related to the fact that the coefficient on the variable interacting "Early" Stealth Rock with Circle Throw is negative, though statistically insignificant. This in of itself is not alarming. What is alarming is that the variable interacting “Late” Stealth Rock with Circle throw is both positive and statistically significant. This is alarming because the coefficient of this variable ranges from 0.998 to 1.069. As reflected by the standard error ranging from 0.450 to 0.649, this is a result to take with a grain of salt. Simply put, while there is evidence that utilizing damaging complementary moves in conjunction with entry hazards is an effective strategy, there are a number of other move combinations to consider when generalizing the results discussed thus far.

Overall, the inclusion of 415 Pokémon and 39 mega-Pokémon improves both the accuracy of the models and generalizability of the results. Notably, Log Likelihood values and AIC values improve when additional variables are added to the model. This improvement in model quality is also found when comparing models (1) through (5) with models (6) through (10). The inclusion of a time parameterization appears to improve not only model quality, but also interpretation of specific strategies. Thus, the results lend credence to utilizing both entry hazards and complementary moves, most notably moves that damage opposing Pokémon and then force them to switch. Furthermore, evidence indicates that utilizing entry hazards early in a match improves the likelihood a winning a battle more than utilizing entry hazards later in a match. There is additional evidence that utilizing some combination of entry hazards and complementary moves increases the likelihood of winning a battle, implicitly lending support that it is a more effective Pokémon battling strategy than either not using any of the moves or just one of the moves singularly.

Table 3.13: Models 3-5 Basic Move Set

	Dependent variable:		
	Outcome		
	(1)	(2)	(3)
Stealth_Rock	0.200***	0.140***	0.137***
	(0.004)	(0.004)	(0.004)
Spikes	0.063***	0.049***	0.048***
	(0.006)	(0.007)	(0.007)
Toxic_Spikes	−0.090***	0.007	0.010
	(0.028)	(0.028)	(0.028)
Sticky_Web	0.043*	0.164***	0.161***
	(0.023)	(0.029)	(0.029)
Dragon_Tail	−0.045***	−0.062***	−0.069***
	(0.014)	(0.014)	(0.014)
Roar	−0.031	−0.021	−0.022
	(0.020)	(0.020)	(0.020)
Whirlwind	0.017	−0.004	−0.005
	(0.012)	(0.013)	(0.013)
Circle_Throw	−0.055	0.017	0.017
	(0.082)	(0.083)	(0.083)
Constant	−0.074***	0.060***	0.049***
	(0.002)	(0.010)	(0.010)
Observations	424,894	424,894	424,894
Log Likelihood	−292,863.000	−289,365.000	−289,071.800
Akaike Inf. Crit.	585,787.900	579,602.000	579,091.600
Note:	*p<0.1; **p<0.05; ***p<0.01		
	Normal Standard Errors Shown in Parenthesis.		

Table 3.14: Models 3-5 Cont.: Squared Moves

	Dependent variable:		
	Outcome		
	(1)	(2)	(3)
Circle_Throw2	0.006	−0.003	−0.002
	(0.012)	(0.012)	(0.012)
Stealth_Rock2	−0.009***	−0.006***	−0.006***
	(0.001)	(0.001)	(0.001)
Spikes2	−0.004***	−0.003***	−0.003***
	(0.001)	(0.001)	(0.001)
Toxic_Spikes2	0.008	−0.013	−0.013
	(0.012)	(0.011)	(0.011)
Sticky_Web2	−0.004	−0.023*	−0.023*
	(0.011)	(0.013)	(0.013)
Dragon_Tail2	0.006**	0.008***	0.009***
	(0.003)	(0.003)	(0.003)
Roar2	0.005	0.005	0.004
	(0.004)	(0.004)	(0.004)
Whirlwind2	0.001	0.002	0.002
	(0.001)	(0.002)	(0.002)
Observations	424,894	424,894	424,894
Log Likelihood	−292,863.000	−289,365.000	−289,071.800
Akaike Inf. Crit.	585,787.900	579,602.000	579,091.600

Note: *p<0.1; **p<0.05; ***p<0.01
Normal Standard Errors Shown in Parenthesis.

Table 3.15: Models 3-5 Cont.: Squared Moves with Interactions

	Dependent variable:		
	Outcome		
	(1)	(2)	(3)
Stealth_Rock_Spikes2	0.001***	0.001***	0.001***
	(0.0002)	(0.0002)	(0.0002)
Stealth_Rock_Sticky_Web2	0.007**	−0.001	−0.002
	(0.003)	(0.014)	(0.014)
Stealth_Rock_Toxic_Spikes2	0.015	0.015*	0.016*
	(0.010)	(0.009)	(0.009)
Stealth_Rock_Whirlwind2	−0.00001	−0.0005	−0.001
	(0.001)	(0.001)	(0.001)
Stealth_Rock_Dragon_Tail2	−0.005***	−0.005***	−0.005***
	(0.002)	(0.002)	(0.002)
Stealth_Rock_Roar2	−0.001	−0.001	−0.001
	(0.002)	(0.002)	(0.002)
Stealth_Rock_Circle_Throw2	−0.041	−0.035	−0.035
	(0.037)	(0.037)	(0.037)
Observations	424,894	424,894	424,894
Log Likelihood	−292,863.000	−289,365.000	−289,071.800
Akaike Inf. Crit.	585,787.900	579,602.000	579,091.600

Note: *p<0.1; **p<0.05; ***p<0.01
Normal Standard Errors Shown in Parenthesis.

Table 3.16: Models 3-5 Cont.: Move Set Interactions

	Dependent variable:		
	Outcome		
	(1)	(2)	(3)
Stealth_Rock_Spikes	-0.023^{***}	-0.014^{***}	-0.013^{***}
	(0.004)	(0.004)	(0.004)
Stealth_Rock_Sticky_Web	-0.101^{***}	-0.048	-0.041
	(0.022)	(0.034)	(0.034)
Stealth_Rock_Toxic_Spikes	-0.051^{*}	-0.041	-0.041
	(0.028)	(0.028)	(0.028)
Stealth_Rock_Whirlwind	-0.011	-0.003	-0.003
	(0.007)	(0.008)	(0.007)
Stealth_Rock_Dragon_Tail	0.030^{***}	0.032^{***}	0.030^{***}
	(0.011)	(0.011)	(0.011)
Stealth_Rock_Roar	-0.009	-0.004	-0.004
	(0.014)	(0.014)	(0.014)
Stealth_Rock_Circle_Throw	0.290	0.297	0.295
	(0.186)	(0.187)	(0.187)
Observations	424,894	424,894	424,894
Log Likelihood	−292,863.000	−289,365.000	−289,071.800
Akaike Inf. Crit.	585,787.900	579,602.000	579,091.600
Note:	*p<0.1; **p<0.05; ***p<0.01		
	Normal Standard Errors Shown in Parenthesis.		

Table 3.17: Models 8-10 Basic Move Set

	Dependent variable:		
	Outcome		
	(1)	(2)	(3)
Early_Stealth_Rock	0.250***	0.193***	0.190***
	(0.005)	(0.005)	(0.005)
Late_Stealth_Rock	0.190***	0.112***	0.108***
	(0.006)	(0.006)	(0.006)
Early_Spikes	0.070***	0.049***	0.049***
	(0.017)	(0.017)	(0.017)
Late_Spikes	0.122***	0.069***	0.066***
	(0.018)	(0.019)	(0.019)
Early_Toxic_Spikes	−0.075***	0.012	0.016
	(0.029)	(0.030)	(0.030)
Late_Toxic_Spikes	−0.183***	−0.093**	−0.093**
	(0.037)	(0.038)	(0.038)
Early_Sticky_Web	0.067***	0.157***	0.153***
	(0.020)	(0.024)	(0.024)
Late_Sticky_Web	−0.038	0.059	0.060
	(0.044)	(0.045)	(0.045)
Observations	424,894	424,894	424,894
Log Likelihood	−292,536.500	−289,107.100	−288,817.300
Akaike Inf. Crit.	585,163.000	579,114.300	578,612.500

Note: *p<0.1; **p<0.05; ***p<0.01

Normal Standard Errors Shown in Parenthesis.

Table 3.18: Models 8-10 Cont.: Complementary Move Set and Early Entry Hazards

	Dependent variable:		
	Outcome		
	(1)	(2)	(3)
Circle_Throw2	0.005	−0.004	−0.004
	(0.012)	(0.012)	(0.012)
Dragon_Tail2	0.017***	0.018***	0.019***
	(0.004)	(0.004)	(0.004)
Roar2	0.007	0.008	0.008
	(0.006)	(0.006)	(0.006)
Whirlwind2	−0.00002	0.001	0.001
	(0.002)	(0.002)	(0.002)
Constant	−0.083***	0.056***	0.042***
	(0.002)	(0.010)	(0.010)
Observations	424,894	424,894	424,894
Log Likelihood	−292,536.500	−289,107.100	−288,817.300
Akaike Inf. Crit.	585,163.000	579,114.300	578,612.500
Note:			*p<0.1; **p<0.05; ***p<0.01 Normal Standard Errors Shown in Parenthesis.

Table 3.19: Models 8-10 Cont.: Early Move Interactions

	Dependent variable:		
	Outcome		
	(1)	(2)	(3)
Early_Stealth_RockXWhirlwind2	0.002	0.002	0.001
	(0.002)	(0.002)	(0.002)
Early_Stealth_RockXDragon_Tail2	-0.015^{***}	-0.012^{**}	-0.011^{**}
	(0.005)	(0.005)	(0.005)
Early_Stealth_RockXRoar2	-0.0003	-0.003	-0.003
	(0.006)	(0.006)	(0.006)
Early_Stealth_RockXCircle_Throw2	0.046	0.046	0.047
	(0.071)	(0.066)	(0.067)
Late_Stealth_RockXWhirlwind2	0.001	-0.001	-0.001
	(0.002)	(0.002)	(0.002)
Late_Stealth_RockXDragon_Tail2	-0.019^{***}	-0.019^{***}	-0.019^{***}
	(0.005)	(0.005)	(0.005)
Late_Stealth_RockXRoar2	-0.006	-0.007	-0.007
	(0.006)	(0.006)	(0.006)
Late_Stealth_RockXCircle_Throw2	-0.231^{**}	-0.241^{**}	-0.240^{**}
	(0.107)	(0.116)	(0.116)
Observations	424,894	424,894	424,894
Log Likelihood	$-292,536.500$	$-289,107.100$	$-288,817.300$
Akaike Inf. Crit.	585,163.000	579,114.300	578,612.500

Note: *p<0.1; **p<0.05; ***p<0.01
Normal Standard Errors Shown in Parenthesis.

Table 3.20: Models 8-10 Cont.: Early and Late Interactions Cont.

	Dependent variable:		
	Outcome		
	(1)	(2)	(3)
Early_Stealth_RockXEarly_Spikes	−0.029	0.015	0.019
	(0.025)	(0.026)	(0.026)
Early_Stealth_RockXLate_Spikes	−0.048*	−0.022	−0.020
	(0.025)	(0.025)	(0.025)
Early_Stealth_RockXEarly_Sticky_Web	−0.121***	−0.014	−0.009
	(0.035)	(0.038)	(0.038)
Early_Stealth_RockXLate_Sticky_Web	−0.219***	−0.216***	−0.218***
	(0.077)	(0.077)	(0.077)
Early_Stealth_RockXEarly_Toxic_Spikes	−0.093*	−0.057	−0.057
	(0.049)	(0.049)	(0.050)
Early_Stealth_RockXLate_Toxic_Spikes	0.010	0.017	0.018
	(0.059)	(0.059)	(0.059)
Early_Stealth_RockXWhirlwind	−0.037*	−0.021	−0.020
	(0.019)	(0.020)	(0.020)
Early_Stealth_RockXDragon_Tail	0.119***	0.107***	0.101***
	(0.021)	(0.021)	(0.021)
Observations	424,894	424,894	424,894
Log Likelihood	−292,536.500	−289,107.100	−288,817.300
Akaike Inf. Crit.	585,163.000	579,114.300	578,612.500
Note:			*p<0.1; **p<0.05; ***p<0.01 Normal Standard Errors Shown in Parenthesis.

Table 3.21: Models 8-10 Cont.: Early and Late Interactions Cont.

	Dependent variable:		
	Outcome		
	(1)	(2)	(3)
Early_Stealth_RockXRoar	0.021	0.028	0.031
	(0.029)	(0.029)	(0.029)
Early_Stealth_RockXCircle_Throw	−0.019	−0.015	−0.022
	(0.263)	(0.259)	(0.260)
Late_Stealth_RockXEarly_Spikes	−0.043	−0.035	−0.035
	(0.030)	(0.030)	(0.030)
Late_Stealth_RockXLate_Spikes	−0.047*	0.006	0.009
	(0.025)	(0.025)	(0.025)
Late_Stealth_RockXEarly_Sticky_Web	−0.133**	−0.103*	−0.094*
	(0.055)	(0.055)	(0.055)
Late_Stealth_RockXLate_Sticky_Web	−0.006	0.072	0.078
	(0.071)	(0.072)	(0.072)
Late_Stealth_RockXEarly_Toxic_Spikes	0.014	0.006	0.006
	(0.062)	(0.062)	(0.062)
Late_Stealth_RockXLate_Toxic_Spikes	0.052	0.050	0.050
	(0.060)	(0.060)	(0.060)
Observations	424,894	424,894	424,894
Log Likelihood	−292,536.500	−289,107.100	−288,817.300
Akaike Inf. Crit.	585,163.000	579,114.300	578,612.500

Note: *p<0.1; **p<0.05; ***p<0.01
Normal Standard Errors Shown in Parenthesis.

Table 3.22: Models 8-10 Cont.: Complementary Move Set and Late Interactions

	Dependent variable:		
	Outcome		
	(1)	(2)	(3)
Dragon_Tail	-0.115^{***}	-0.123^{***}	-0.128^{***}
	(0.017)	(0.018)	(0.018)
Roar	-0.063^{**}	-0.051^{**}	-0.053^{**}
	(0.026)	(0.026)	(0.026)
Whirlwind	0.035^{**}	0.009	0.008
	(0.016)	(0.017)	(0.017)
Circle_Throw	-0.040	0.031	0.031
	(0.082)	(0.083)	(0.083)
Late_Stealth_RockXWhirlwind	-0.033^{*}	-0.013	-0.011
	(0.018)	(0.019)	(0.019)
Late_Stealth_RockXDragon_Tail	0.093^{***}	0.093^{***}	0.090^{***}
	(0.022)	(0.022)	(0.021)
Late_Stealth_RockXRoar	0.024	0.026	0.026
	(0.029)	(0.029)	(0.029)
Late_Stealth_RockXCircle_Throw	0.998^{**}	1.069^{**}	1.069^{**}
	(0.450)	(0.468)	(0.469)
Observations	424,894	424,894	424,894
Log Likelihood	$-292,536.500$	$-289,107.100$	$-288,817.300$
Akaike Inf. Crit.	585,163.000	579,114.300	578,612.500
Note:			*p<0.1; **p<0.05; ***p<0.01
			Normal Standard Errors Shown in Parenthesis.

Chapter 4

Conclusion

Overall, the model quality improved when more parameters were added, including both Pokémon, mega-Pokémon, and time indicators. Including interactions between Stealth Rock and other move variables provides some method of empirically testing player strategies. Generally, the inclusion of interactions between Stealth Rock and other entry hazards indicate that Stealth Rock positively impacts the liklihood of winning a battle, and these results are robust to a number of model specifications and interactions with complementary moves.

Overall, nearly all of the four entry hazards were statistically significant across model specifications, indicating variability in utilizing different patient moves. Furthermore, all entry hazards positively impact a player's liklihood of winning a battle, at least in the final model specification. Both Stealth Rock and Spikes positively impact a player's probability of winning a battle while retaining statistical significance. Surprisingly, the interaction between these two variables and complementary moves varied across model specifications. Because of this, there are a number of interactions and other underlying factors that could be responsible for the signage of specific move interactions. Nonetheless there is general evidence that different entry hazards contribute differently to a player's win outcome, and the use of damaging complementary moves in particular positively impact the liklihood of winning a Pokémon battle more than just the singular use of one entry hazard. This result provides some indication that different types of moves can act in synergy. Some specific move combinations should be taken with a grain of salt however, notably those including interactions with Circle Throw, as the the coefficent of using both Stealth Rock and Circle Throw was greater in magnitude than the coefficient of just Stealth Rock and was not statistically significant across any specifications.

That being said, there are a number of different ways to expand upon this study. These include expanding the Pokémon roster, expanding the number of moves and types of move sets included in models, expanding the number of interactions between move variables, and expanding the set of Pokémon battling formats. Each will be detailed in the order given.

The most obvious extension to this study is the inclusion of more Pokémon. With the recent release of Pokémon Sun and Moon, both new species of Pokémon and variants of previously existing Pokémon expanded the number of possible Pokémon to choose from. This includes new Pokémon within the OU format. With 81 new Pokémon to choose from, there is a clear opportunity to see if the same results found in this study continue to dominant the Pokémon battling scene. Similarly, Pokémon Sun and Moon added 80 new moves. Though no new entry hazards were added in the latest iteration, there are a host of other moves to consider. Some of these new moves even affect the battle environment. Clearly some combination of the 80 new moves and moves not detailed in this study could cover a great deal of ground simply not included in the current study. Additionally, the types of moves considered in this study is limited. With well over 700 different moves before the release of Sun and Moon, this point can apply even to the data used in this study, especially as it pertaining to status condition moves or moves with different accuracies.

Furthermore, the only format consider in this study is the OU format. It would be interesting to see if the use of entry hazards has the same effect in the Randbats format, or even other battle formats where team composition is dictated by players. If the roster of Pokémon was further restricted, as is found in lower tier battle formats such as UU, Pokémon-specific variables could provide some prescriptive information in choosing the composition of one's team. Additionally, if the results of this study were verified in other formats, the strategies highlighted in this study would be robust to battle formats, thus improving this study's external validity.

It is important to bear in mind that the observations used only span a few days. By expanding this to weeks, or even a months worth of data, the results may lead to entirely different conclusions. The same goes for what year the data comes from. At the very least however, this study has proved that patient strategy sets significantly impact the likelihood of winning a game. Furthermore, patient strategy sets are further enhanced by utilizing complementary moves, though results are mixed depending on what moves are specifically considered.

Nonetheless, the general results are robust to a series of specifications, including Pokémon choice, mega-Pokémon choice, and interactions between different moves. Additionally, the inclusion of each of these components improved the quality of models, but only up to a point. Given the inclusion of mega-Pokémon and full Pokémon roster each improved model quality by the same amount, perhaps some further probing is necessary to tease out team composition variables.

Out of all the formal and informal hypotheses explored in this study, one remains consistently true: Pokémon remains a complex game that cannot be diluted into simple prescriptions of using one Pokémon over another. The world of Pokémon is expansive and consistently changing, but is always open to inquiry for those willing to explore and dig through the data.

Chapter 5

Appendices

5.1 Appendix A: Summary Statistics of Pokémon and Mega-Pokémon

Table 5.1: Pokémon Summary Table 1-40

Statistic	Mean	St. Dev.
Abomasnow	0.007	0.083
Absol	0.012	0.108
Accelgor	0.003	0.050
Aerodactyl	0.013	0.112
Aggron	0.013	0.115
Alakazam	0.067	0.250
Alomomola	0.006	0.075
Altaria	0.035	0.184
Ambipom	0.008	0.090
Amoonguss	0.016	0.126
Ampharos	0.010	0.099
Arbok	0.001	0.030
Arcanine	0.026	0.158
Archeops	0.003	0.050
Ariados	0.001	0.029
Armaldo	0.002	0.042
Aromatisse	0.001	0.031
Articuno	0.002	0.048
Audino	0.002	0.048
Aurorus	0.002	0.046
Avalugg	0.003	0.054
Azelf	0.011	0.103
Azumarill	0.108	0.310
Banette	0.006	0.077
Barbaracle	0.002	0.044
Basculin	0.0001	0.011
Bastiodon	0.002	0.040
Beartic	0.001	0.029
Beautifly	0.0003	0.016
Beedrill	0.014	0.118
Beheeyem	0.001	0.028
Bellossom	0.0004	0.020
Bibarel	0.0004	0.019
Bisharp	0.084	0.277
Blastoise	0.022	0.148
Blissey	0.016	0.127
Bouffalant	0.001	0.036
Braviary	0.002	0.049
Breloom	0.072	0.259

Table 5.2: Pokémon Summary Table 41-80

Statistic	Mean	St. Dev.
Bronzong	0.005	0.069
Butterfree	0.001	0.037
Cacturne	0.002	0.045
Camerupt	0.003	0.058
Carbink	0.001	0.025
Carnivine	0.0002	0.015
Carracosta	0.002	0.044
Castform	0.0003	0.017
Celebi	0.030	0.171
Chandelure	0.020	0.142
Chansey	0.059	0.235
Charizard	0.138	0.345
Chatot	0.002	0.045
Cherrim	0.0003	0.018
Chesnaught	0.012	0.108
Chimecho	0.0002	0.015
Cinccino	0.006	0.075
Clawitzer	0.002	0.049
Claydol	0.002	0.041
Clefable	0.105	0.306
Clefairy	0.0003	0.017
Cloyster	0.022	0.147
Cobalion	0.005	0.067
Cofagrigus	0.008	0.090
Combusken	0.001	0.029
Conkeldurr	0.069	0.254
Corsola	0.0003	0.017
Cradily	0.004	0.067
Crawdaunt	0.012	0.110
Cresselia	0.008	0.089
Crobat	0.017	0.127
Crustle	0.002	0.039
Cryogonal	0.001	0.035
Darmanitan	0.017	0.130
Dedenne	0.003	0.054
Delcatty	0.001	0.023
Delibird	0.002	0.043
Delphox	0.007	0.081
Dewgong	0.0005	0.022
Diancie	0.038	0.191
Diggersby	0.013	0.113

Table 5.3: Pokémon Summary Table 81-120

Statistic	Mean	St. Dev.
Ditto	0.008	0.091
Dodrio	0.001	0.030
Donphan	0.015	0.122
Doublade	0.007	0.086
Dragalge	0.008	0.088
Dragonair	0.0003	0.018
Dragonite	0.086	0.280
Drapion	0.007	0.082
Drifblim	0.002	0.041
Druddigon	0.002	0.042
Dugtrio	0.008	0.091
Dunsparce	0.0005	0.021
Duosion	0.00004	0.006
Durant	0.003	0.057
Dusclops	0.004	0.066
Dusknoir	0.003	0.058
Dustox	0.0002	0.015
Eelektross	0.006	0.079
Electivire	0.012	0.110
Electrode	0.001	0.035
Emboar	0.004	0.064
Emolga	0.002	0.045
Empoleon	0.014	0.118
Entei	0.010	0.101
Escavalier	0.003	0.056
Espeon	0.027	0.162
Excadrill	0.099	0.299
Exeggutor	0.003	0.050
Exploud	0.003	0.056
Farfetchd	0.0002	0.015
Fearow	0.0003	0.016
Feraligatr	0.016	0.125
Ferroseed	0.0003	0.016
Ferrothorn	0.131	0.337
Flareon	0.003	0.055
Fletchinder	0.0001	0.012
Floatzel	0.002	0.045
Florges	0.010	0.101
Flygon	0.006	0.074
Forretress	0.017	0.128

Table 5.4: Pokémon Summary Table 121-160

Statistic	Mean	St. Dev.
Fraxure	0.00004	0.007
Froslass	0.006	0.078
Furfrou	0.001	0.028
Furret	0.0004	0.020
Gabite	0.0002	0.014
Gallade	0.027	0.163
Galvantula	0.018	0.133
Garbodor	0.001	0.027
Garchomp	0.165	0.371
Gardevoir	0.058	0.233
Gastrodon	0.011	0.102
Gengar	0.120	0.325
Gigalith	0.001	0.034
Girafarig	0.0001	0.012
Glaceon	0.003	0.054
Glalie	0.002	0.047
Gligar	0.001	0.029
Gliscor	0.091	0.287
Gogoat	0.001	0.032
Golbat	0.001	0.032
Golduck	0.001	0.029
Golem	0.004	0.064
Golurk	0.003	0.051
Goodra	0.024	0.153
Gorebyss	0.0005	0.022
Gothitelle	0.001	0.027
Gourgeist	0.0003	0.017
Granbull	0.002	0.041
Grumpig	0.0003	0.017
Gurdurr	0.0002	0.013
Gyarados	0.053	0.224
Hariyama	0.002	0.042
Haunter	0.001	0.024
Hawlucha	0.017	0.130
Haxorus	0.012	0.107
Heatmor	0.0003	0.016
Heatran	0.134	0.341
Heliolisk	0.008	0.090
Heracross	0.024	0.154
Hippowdon	0.043	0.202

Table 5.5: Pokémon Summary Table 161-200

Statistic	Mean	St. Dev.
Hitmonchan	0.003	0.052
Hitmonlee	0.005	0.069
Hitmontop	0.004	0.060
Honchkrow	0.006	0.079
Hoopa	0.001	0.038
HoopaU	0.000	0.000
Houndoom	0.007	0.085
Huntail	0.0002	0.013
Hydreigon	0.018	0.134
Hypno	0.001	0.025
Illumise	0.0002	0.014
Infernape	0.028	0.165
Jellicent	0.007	0.085
Jirachi	0.050	0.218
Jolteon	0.021	0.145
Jumpluff	0.001	0.030
Jynx	0.002	0.041
Kabutops	0.006	0.075
Kadabra	0.0002	0.013
Kangaskhan	0.001	0.026
Kecleon	0.003	0.055
Keldeo	0.053	0.223
Kingdra	0.015	0.122
Kingler	0.002	0.047
Klang	0.0001	0.009
Klefki	0.043	0.202
Klinklang	0.001	0.038
Kricketune	0.0003	0.018
Krokorok	0.0001	0.008
Krookodile	0.012	0.107
Kyurem	0.002	0.043
KyuremB	0.000	0.000
LandorusT	0.000	0.000
Lanturn	0.004	0.060
Lapras	0.007	0.083
Latias	0.067	0.250
Latios	0.092	0.289
Leafeon	0.003	0.056
Leavanny	0.001	0.035
Ledian	0.0004	0.021

Table 5.6: Pokémon Summary Table 201-240

Statistic	Mean	St. Dev.
Lickilicky	0.001	0.038
Liepard	0.002	0.050
Lilligant	0.002	0.046
Linoone	0.002	0.045
Lopunny	0.056	0.229
Lucario	0.020	0.142
Ludicolo	0.007	0.080
Lumineon	0.0001	0.010
Lunatone	0.0004	0.020
Luvdisc	0.00004	0.007
Luxray	0.004	0.067
Machamp	0.012	0.109
Machoke	0.001	0.022
Magcargo	0.001	0.027
Magmortar	0.004	0.061
Magneton	0.003	0.052
Magnezone	0.047	0.212
Malamar	0.005	0.073
Mamoswine	0.018	0.133
Manaphy	0.049	0.216
Mandibuzz	0.015	0.122
Manectric	0.045	0.208
Mantine	0.001	0.035
Maractus	0.0003	0.018
Marowak	0.002	0.049
Masquerain	0.001	0.027
Mawile	0.001	0.032
Medicham	0.034	0.180
Meganium	0.002	0.043
Meloetta	0.003	0.059
Meowstic	0.004	0.060
Mesprit	0.001	0.024
Metagross	0.067	0.250
Metang	0.0001	0.010
Mew	0.040	0.195
Mienshao	0.007	0.082
Mightyena	0.0005	0.022
Milotic	0.024	0.154
Miltank	0.002	0.050
Minun	0.0002	0.015

Table 5.7: Pokémon Summary Table 241-280

Statistic	Mean	St. Dev.
Misdreavus	0.0004	0.019
Mismagius	0.004	0.065
Moltres	0.001	0.036
Monferno	0.0001	0.008
Mothim	0.0001	0.011
MrMime	0.001	0.032
Muk	0.003	0.051
Murkrow	0.001	0.032
Musharna	0.001	0.029
Nidoking	0.017	0.129
Nidoqueen	0.003	0.054
Ninetales	0.012	0.109
Ninjask	0.004	0.062
Noctowl	0.001	0.026
Noivern	0.009	0.093
Octillery	0.001	0.031
Omastar	0.003	0.054
Pachirisu	0.001	0.028
Pangoro	0.003	0.055
Parasect	0.0003	0.016
Pawniard	0.0002	0.013
Pelipper	0.001	0.024
Persian	0.001	0.037
Phione	0.0001	0.008
Pidgeot	0.015	0.122
Piloswine	0.001	0.032
Pinsir	0.032	0.177
Plusle	0.0001	0.011
Politoed	0.021	0.143
Poliwrath	0.002	0.045
PorygonZ	0.007	0.086
Porygon2	0.010	0.098
Primeape	0.001	0.038
Prinplup	0.00005	0.007
Probopass	0.001	0.035
Purugly	0.001	0.022
Pyroar	0.002	0.048
Quagsire	0.013	0.112
Quilladin	0.0001	0.010
Qwilfish	0.001	0.025

Table 5.8: Pokémon Summary Table 281-320

Statistic	Mean	St. Dev.
Raichu	0.004	0.065
Raikou	0.052	0.221
Rampardos	0.002	0.044
Rapidash	0.001	0.038
Raticate	0.001	0.030
Regice	0.001	0.030
Regigigas	0.001	0.028
Regirock	0.001	0.031
Registeel	0.001	0.038
Relicanth	0.001	0.023
Reuniclus	0.007	0.085
Rhydon	0.001	0.033
Rhyperior	0.008	0.089
Roselia	0.0002	0.013
Roserade	0.011	0.106
Rotom	0.001	0.024
RotomC	0.000	0.000
RotomF	0.000	0.000
RotomH	0.000	0.000
RotomS	0.000	0.000
RotomW	0.000	0.000
Sableye	0.064	0.244
Salamence	0.017	0.129
Samurott	0.003	0.052
Sandslash	0.002	0.041
Sawk	0.002	0.044
Sawsbuck	0.002	0.043
Sceptile	0.025	0.156
Scizor	0.126	0.332
Scolipede	0.015	0.121
Scrafty	0.010	0.099
Scyther	0.001	0.037
Seaking	0.001	0.029
Seismitoad	0.007	0.086
Serperior	0.078	0.268
Servine	0.0001	0.008
Seviper	0.001	0.029
Sharpedo	0.009	0.093
Shaymin	0.002	0.050
Shedinja	0.005	0.070

Table 5.9: Pokémon Summary Table 321-360

Statistic	Mean	St. Dev.
Shiftry	0.002	0.044
Shuckle	0.013	0.114
Sigilyph	0.006	0.079
Simipour	0.0002	0.016
Simisage	0.0004	0.019
Simisear	0.0002	0.015
Skarmory	0.074	0.262
Skuntank	0.001	0.025
Slaking	0.003	0.055
Slowbro	0.059	0.236
Slowking	0.006	0.080
Slurpuff	0.007	0.086
Smeargle	0.007	0.084
Sneasel	0.0002	0.014
Snorlax	0.019	0.137
Solrock	0.0004	0.021
Spinda	0.001	0.023
Spiritomb	0.004	0.059
Stantler	0.001	0.035
Staraptor	0.020	0.140
Starmie	0.081	0.273
Steelix	0.007	0.082
Stoutland	0.002	0.044
Stunfisk	0.001	0.025
Sudowoodo	0.001	0.026
Suicune	0.012	0.109
Sunflora	0.0002	0.013
Swalot	0.0004	0.020
Swampert	0.032	0.175
Swanna	0.001	0.024
Swellow	0.003	0.055
Swoobat	0.001	0.037
Sylveon	0.067	0.250
Talonflame	0.129	0.335
Tangela	0.001	0.028
Tangrowth	0.005	0.070
Tauros	0.002	0.043
Tentacruel	0.021	0.145
Terrakion	0.014	0.117
Throh	0.001	0.033

Table 5.10: Pokémon Summary Table 361-400

Statistic	Mean	St. Dev.
Thundurus	0.054	0.226
ThundurusT	0.000	0.000
Togekiss	0.040	0.195
Togetic	0.001	0.036
Torkoal	0.003	0.055
Tornadus	0.001	0.032
TornadusT	0.000	0.000
Torterra	0.005	0.069
Toxicroak	0.008	0.090
Trevenant	0.009	0.094
Tropius	0.001	0.030
Typhlosion	0.006	0.079
Tyranitar	0.090	0.286
Tyrantrum	0.006	0.079
Umbreon	0.026	0.159
Unfezant	0.001	0.028
Unown	0.0001	0.011
Ursaring	0.002	0.044
Uxie	0.001	0.037
Vanilluxe	0.001	0.023
Vaporeon	0.016	0.127
Venomoth	0.001	0.039
Venusaur	0.071	0.257
Vespiquen	0.001	0.026
Vibrava	0.00002	0.004
Victini	0.022	0.146
Victreebel	0.001	0.034
Vigoroth	0.001	0.026
Vileplume	0.002	0.039
Virizion	0.001	0.038
Vivillon	0.003	0.052
Volbeat	0.001	0.036
Volcarona	0.039	0.194
Vullaby	0.00003	0.006
Wailord	0.001	0.025
Walrein	0.002	0.041
Wartortle	0.0002	0.013
Watchog	0.0001	0.012
Weavile	0.077	0.267

Table 5.11: Pokémon Summary Table 401-415

Statistic	Mean	St. Dev.
Weezing	0.006	0.078
Whimsicott	0.012	0.107
Whiscash	0.0005	0.022
Wigglytuff	0.001	0.031
Wobbuffet	0.001	0.033
Wormadam	0.00005	0.007
WormadamSandy	0.0001	0.008
WormadamTrash	0.00004	0.006
Xatu	0.003	0.056
Yanmega	0.003	0.057
Zangoose	0.002	0.050
Zapdos	0.021	0.142
Zebstrika	0.001	0.035
Zoroark	0.010	0.097
Zweilous	0.00005	0.007
Zygarde	0.006	0.074

Table 5.12: Summary Table Mega-Pokémon

Statistic	Mean	St. Dev.
Abomasite	0.005	0.073
Absolite	0.010	0.102
Aerodactylite	0.009	0.093
Aggronite	0.008	0.092
Alakazite	0.038	0.190
Altarianite	0.035	0.184
Ampharosite	0.008	0.089
Audinite	0.002	0.041
Banettite	0.006	0.074
Beedrillite	0.014	0.118
Blastoisinite	0.014	0.116
Cameruptite	0.003	0.054
Charizarditex	0.079	0.270
Charizarditey	0.056	0.229
Diancite	0.035	0.185
Galladite	0.024	0.154
Garchompite	0.020	0.139
Gardevoirite	0.048	0.213
Glalitite	0.002	0.046
Gyaradosite	0.027	0.163
Heracronite	0.018	0.134
Houndoominite	0.006	0.075
Latiasite	0.007	0.086
Latiosite	0.008	0.088
Lopunnite	0.056	0.229
Manectite	0.043	0.203
Medichamite	0.032	0.176
Metagrossite	0.055	0.227
Pidgeotite	0.015	0.120
Pinsirite	0.032	0.177
Sablenite	0.046	0.210
Sceptilite	0.021	0.143
Scizorite	0.059	0.236
Sharpedonite	0.006	0.076
Slowbronite	0.015	0.122
Steelixite	0.004	0.063
Swampertite	0.021	0.142
Tyranitarite	0.018	0.132
Venusaurite	0.059	0.235

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