Pokémon Base Stats: Is Pokémon World Balanced?

Introduction:

The Pokémon game world is not as friendly as the anime showed, In the games, players primarily focus on battle strength rather than companionship, as the main objective is to defeat other players or NPCs. A Pokémon's base stats directly influence these battles and play a major role in shaping player decisions.

As of now, the franchise has reached its ninth generation. This raises several questions:

Have Pokémon become more balanced across generations?

Do starter Pokémon have equal stats?

Do base stats have any impact on the sales performance of Pokémon games?

This report analyzes Pokémon base stats to explore these questions.

Base Stats, official called Species Strengths in Pokémon game, are inherent values for each Pokémon species, dictating the general range of stats for that species.

Each Pokémon has six base stats that influence different aspects of battle performance:

HP (Hit Points): Determines how much damage a Pokémon can withstand before fainting.

Attack: Partly determines how much damage a Pokémon deals when using a physical move.

Defense: Partly determines how much damage a Pokémon receives when hit by a physical move.

Special Attack: Partly determines how much damage a Pokémon deals when using a special move.

Special Defense: Partly determines how much damage a Pokémon receives when hit by a special move.

Speed: Determines which Pokémon moves first in battle when using moves of the same priority.

The total of these six values is known as the "Total Stats", which provides a rough measure of a Pokémon's overall power level. (*References: https://mackfey-csep590a-25wi-*

a7725f7512efb75d5e8861f9283d5e6a0079b34f9.pages.cs.washington.edu/fp/final/base_stats.html)

In our data analysis, we will also use the name “HP”, “Attack”, “Defense”, “Special Attack”, “Special Defense”, “Speed” and “Total Stats” to define a Pokémon’s strengths.

1. Pokémon data collection

We collected Pokémon data through the Pokémon API, focusing on their base stats. In addition, we gathered supporting data for deeper analysis:

ID: Each Pokémon species has their own id, this id is official id and you can find it in any Pokédex or Pokémon official website. for example, the id of pikachu is 25.

Type: In Pokémon, there are 18 distinct types that determine a Pokémon’s strengths, weaknesses, and resistances. These types are used to calculate the effectiveness of moves during battle. The 18 types are: Normal, Fire, Water, Electric, Grass, Ice, Fighting, Poison, Ground, Flying, Psychic, Bug, Rock, Ghost, Dragon, Dark, Steel, and Fairy. Each type has advantages and disadvantages against other types. For example, Water-type moves are strong against Fire-type Pokémon, while Grass-type moves are strong against Water-type Pokémon. (References: https://Pokémondb.net & https://Pokémon.fandom.com)

Generation: There are 9 generations of Pokémon.

Gen 1: id 1-151

Gen 2: id 152-251

Gen 3: id 252-386

Gen 4: id 387-493

Gen 5: id 494-649

Gen 6: id 650-721

Gen 7: id 722-809

Gen 8: id 810-905

Gen 9: id 906-1025

Level: Normally, Pokémons have evolution. Most of Pokémons will evolve 1-2 times. So, we marked the original species as level 1, such as: Bulbasaur, Charmander and Squirtle. Pokémon species after once evolution marked as level 2, such as Ivysaur, Charmeleon and Wartortle. Pokémon species after twice evolution marked as level 3, such as Venusaur, Charizard and Blastoise.

Game Sales Data: To study potential links between stats and commercial success, we collected sales data for mainline Pokémon games:

Unit Sales: Sales of representative games within a generation.

Total Sales: Combined sales of all games in a generation, excluding remakes (e.g., Pokémon FireRed and LeafGreen, which feature Gen 1 Pokémon but were released in Gen 3).

Year: Release date of the representative games.

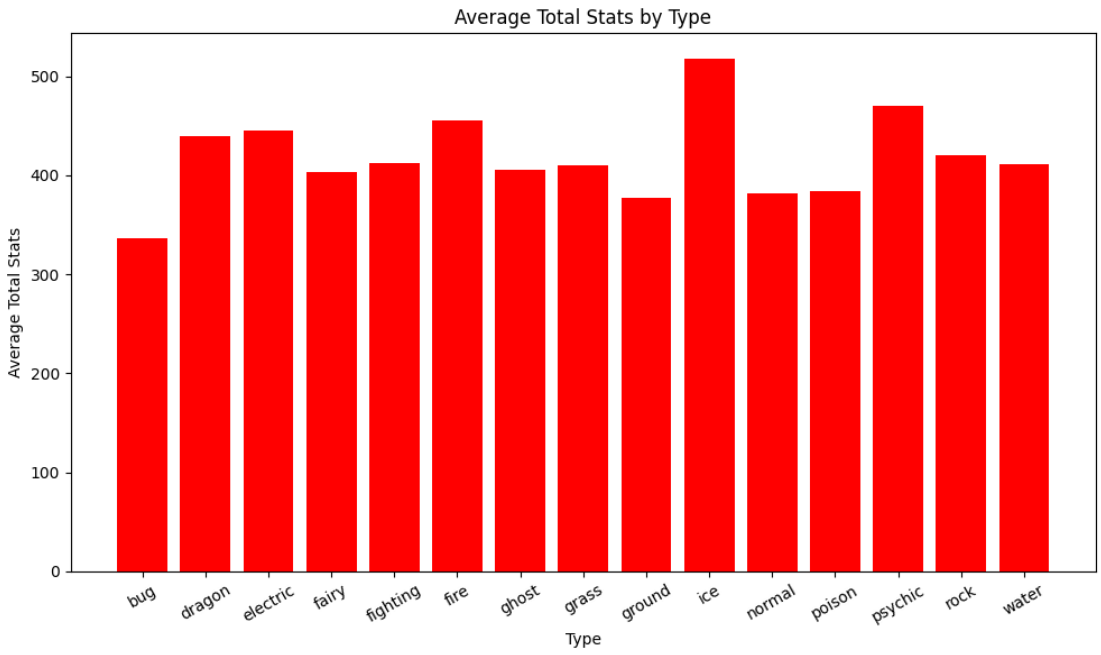
Title	Year	Generation	Units Sales	Total Sales
Pokémon Red / Green / Blue	**1996**	**1**	**31,380,000**	**$46,020,000**
Pokémon Gold / Silver	**1999**	**2**	**23,730,000**	**$30,390,000**
Pokémon Ruby / Sapphire	**2002**	**3**	**16,220,000**	**$16,220,000**
Pokémon Diamond / Pearl	**2006**	**4**	**17,670,000**	**$37,990,000**
Pokémon Black / White	**2010**	**5**	**15,640,000**	**$23,890,000**
Pokémon X / Y	**2013**	**6**	**16,780,000**	**$31,450,000**
Pokémon Sun / Moon	**2016**	**7**	**16,330,000**	**$31,400,000**
Pokémon Sword & Shield	**2019**	**8**	**26,840,000**	**$41,900,000**
Pokémon Scarlet & Violet	**2022**	**9**	**26,790,000**	**$26,790,000**

Form 1.1.1

2. Data analysis:

2.1. Is the Total Stats by type balanced in each generation?

For the first generation (id 1-151), when we calculate the average mean total stats by type, we got the graph 2.1.1:



Graph 2.1.1

In Generation 1, the Pokémon type system was not yet fully developed. Types such as Flying, Dark, and Steel did not exist at this stage. This is a well-known fact, as the early design of Pokémon featured a simpler type structure that was gradually expanded in later generations. The same issue reappears in Generations 2, 3 and 4, where not all current types were equally represented.

According to Graph 2.1.1, the base stats across different types in Generation 1 are not balanced. For example:

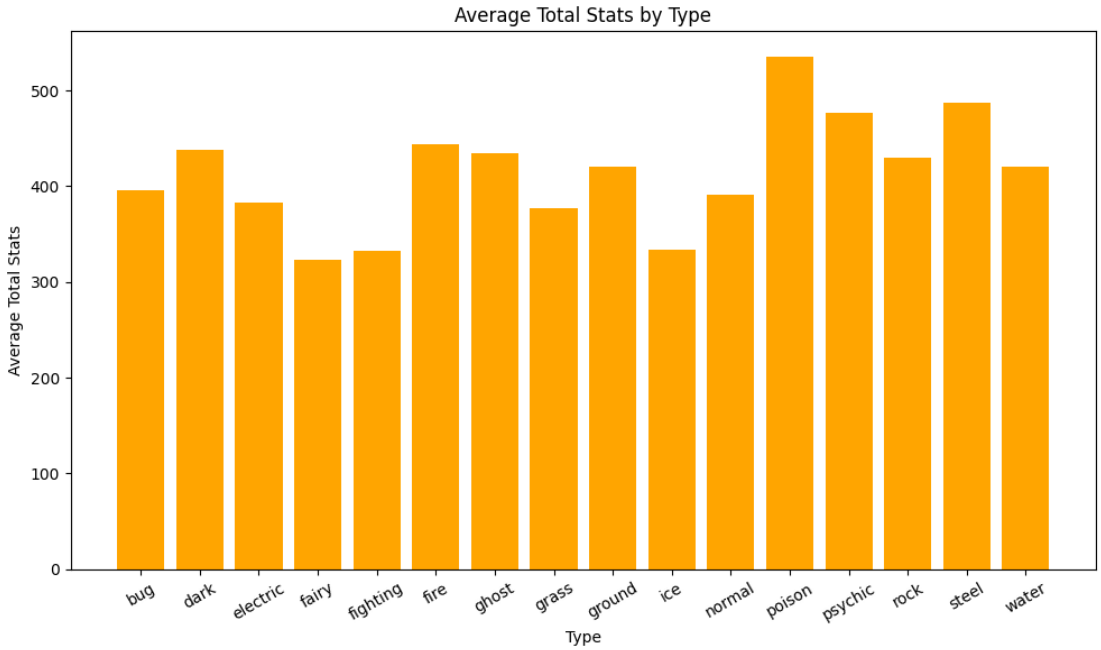
Bug-type Pokémon have the lowest Total Stats. This is because they are typically designed as early-game species—easy to find and catch, often encountered in grassy areas at the beginning of a player's journey. They frequently serve as introductory Pokémon for tutorial battles or beginner missions.

Ice-type Pokémon show the opposite trend. They usually appear later in the game, often as part of the final challenges, and therefore tend to have higher Total Stats.

Dragon and Psychic-type Pokémon are among the rarest and most powerful in the generation. For example, the legendary Pokémon Mew and Mewtwo, as well as the difficult-to-evolve Dragonite, all represent this group with significantly higher stats.

Electric- and Fire-type Pokémon also demonstrate unusually high stats. This may be linked to their prominence in the franchise's branding: Pikachu (Electric-type) and Charizard (Fire-type) are Ash Ketchum's (Satoshi's) signature Pokémon and iconic representatives of the series. Additionally, Electric- and Fire-type Gyms appear in the later stages of the game, which may have influenced the decision to assign these types stronger stats to enhance gameplay challenge.

For the Generation 2 (id 152-251), we got graph 2.1.2:



Graph 2.1.2

The second generation introduced two new types: Dark and Steel. However, no new Dragon-type Pokémon were added, and a pure Flying-type Pokémon still did not exist.

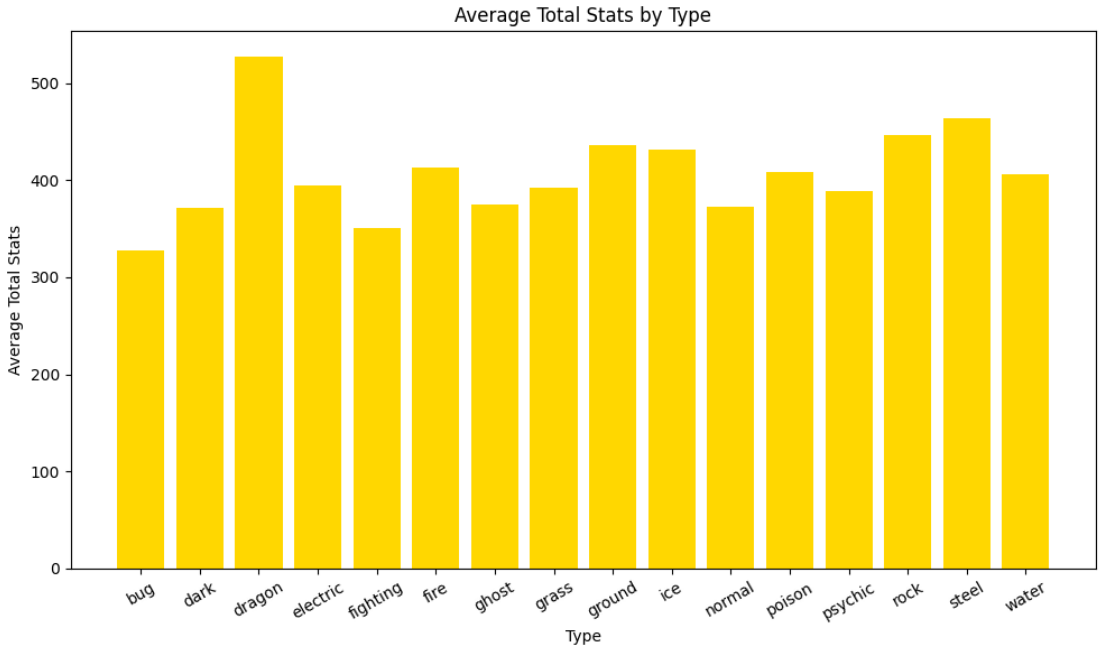
Compared to Generation 1, there are some notable adjustments that seem intended to improve game balance:

Poison-type Pokémon were strengthened, likely to increase their usefulness, since they were considered weaker in Generation 1.

Ice- and Electric-type Pokémon were weakened overall, reducing their dominance from the first generation.

The newly added Dark- and Steel-types were given relatively strong Total Stats. This may have been a deliberate design choice to encourage players to adopt and accept these new types by making them appear powerful and appealing.

For the Generation 3 (id 252-386), we got the graph 2.1.3:

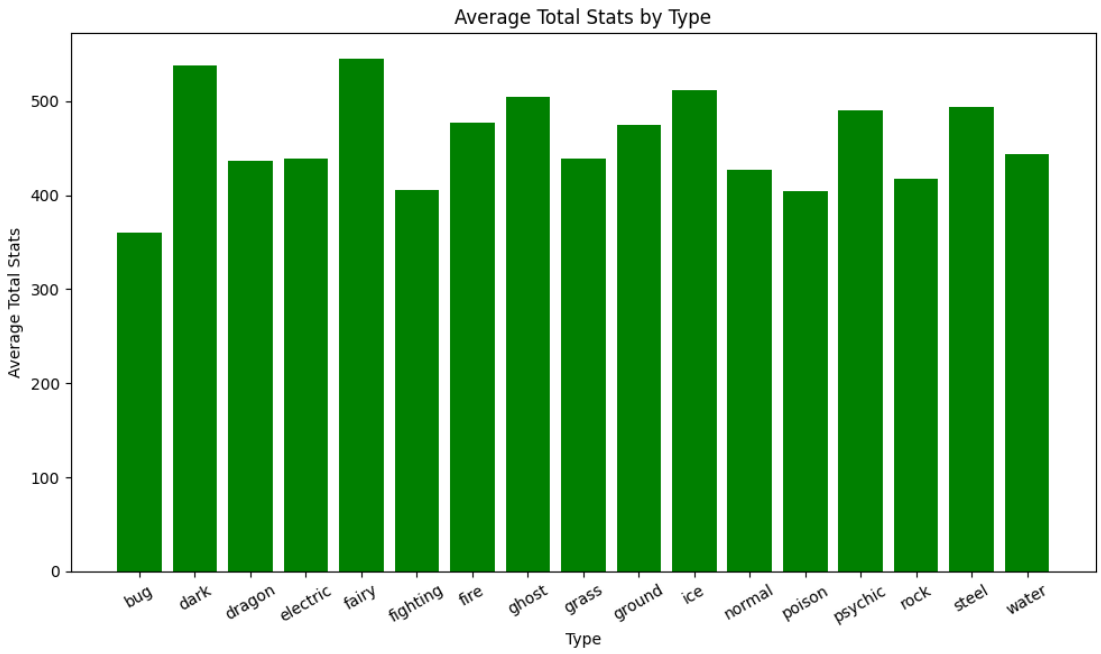


Graph 2.1.3

In Generation 3, there were still no pure Flying-type Pokémon, and the Fairy-type had not yet been introduced. A key change, however, was the noticeable increase in the strength of Dragon-type Pokémon. Since no new Dragons were added in Generation 2, their power appears to have been emphasized in this generation, making them stand out as some of the most dominant species.

For most other types, the overall distribution of Total Stats remained consistent with the patterns established in Generations 1 and 2. There were no major shifts in balance outside of the increased prominence of Dragons.

For the Generation 4 (id 387-493), we got the graph 2.1.4:



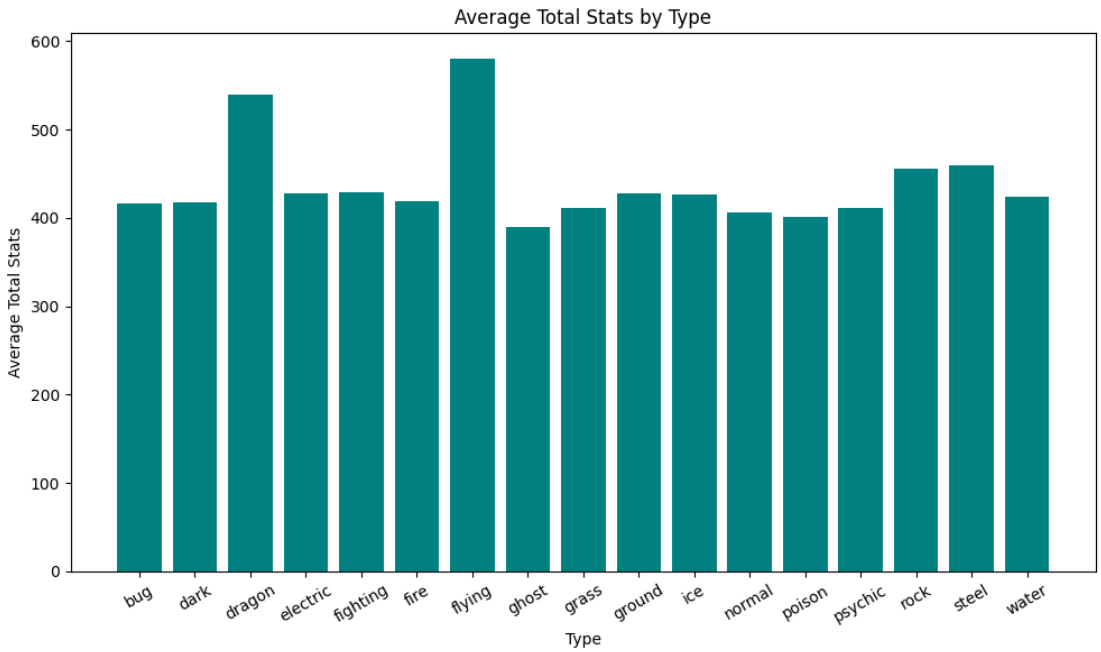
Graph 2.1.4

In Generation 4, a pure Flying-type Pokémon still had not been introduced. Although the Fairy-type itself would not officially debut until Generation 6, some Pokémon later reclassified as Fairy already appeared in this era, often with higher Total Stats and associated with rarity or legendary status.

Another notable shift was the growing strength of Ghost-type Pokémon. They became a more formidable challenge for players, with the legendary Giratina serving as a prime example. Giratina's exceptionally high Total Stats highlighted the increasing importance of Ghost-types in late-game content.

Meanwhile, Dark- and Steel-type Pokémon, first introduced in Generation 2, continued to stand out with relatively high Total Stats, solidifying their role as strong and reliable types within the game's balance.

For the Generation 5 (id 494-649), we got the graph 2.1.5:



Graph 2.1.5

In Generation 5, the long-awaited Flying-type Pokémon finally appeared as a pure type, debuting with some of the highest Total Stats among all types. This suggests that Flying-types were designed to be especially appealing to players.

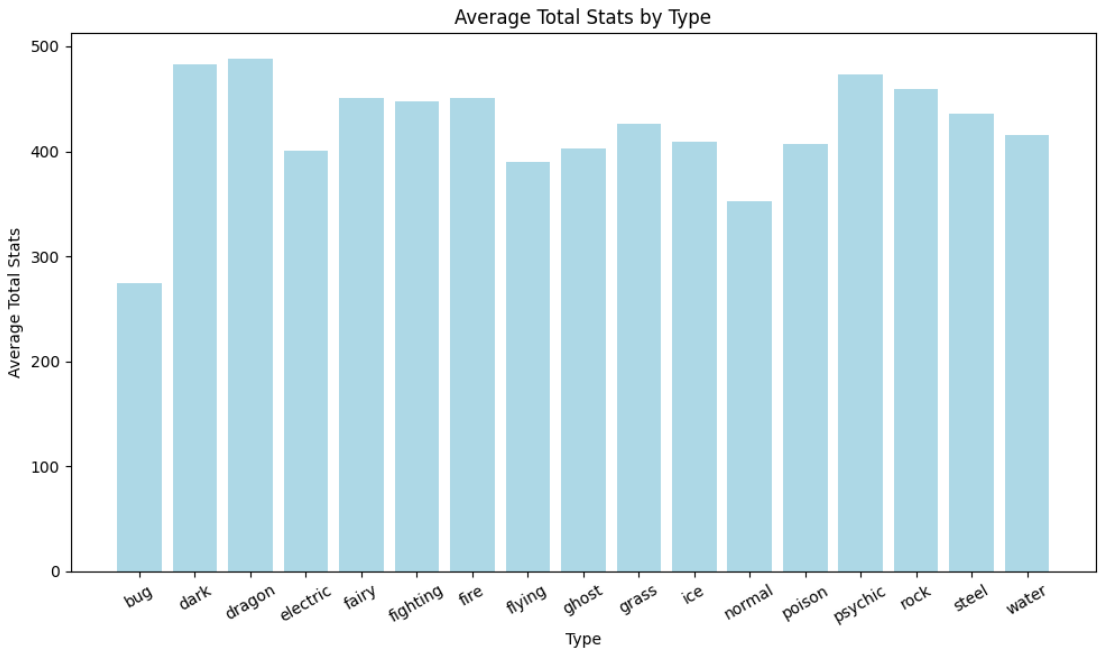
Dragon-types continued to hold their place as a dominant and legendary type, with ideal Total Stats. Notably, the game's cover legendaries—Zekrom and Reshiram—are both Dragon-types, reinforcing their importance within this generation.

On the other hand, Ghost-types were slightly weakened compared to Generation 4, where they had been heavily emphasized through powerful Pokémon like Giratina.

Another key observation is that the highest Total Stats in this generation reached close to 600, showing that Pokémon were becoming stronger overall compared to earlier generations.

At the same time, the distribution of stats across most types became more balanced. This indicates a deliberate design shift, where maintaining fairness and playability between different types grew increasingly important.

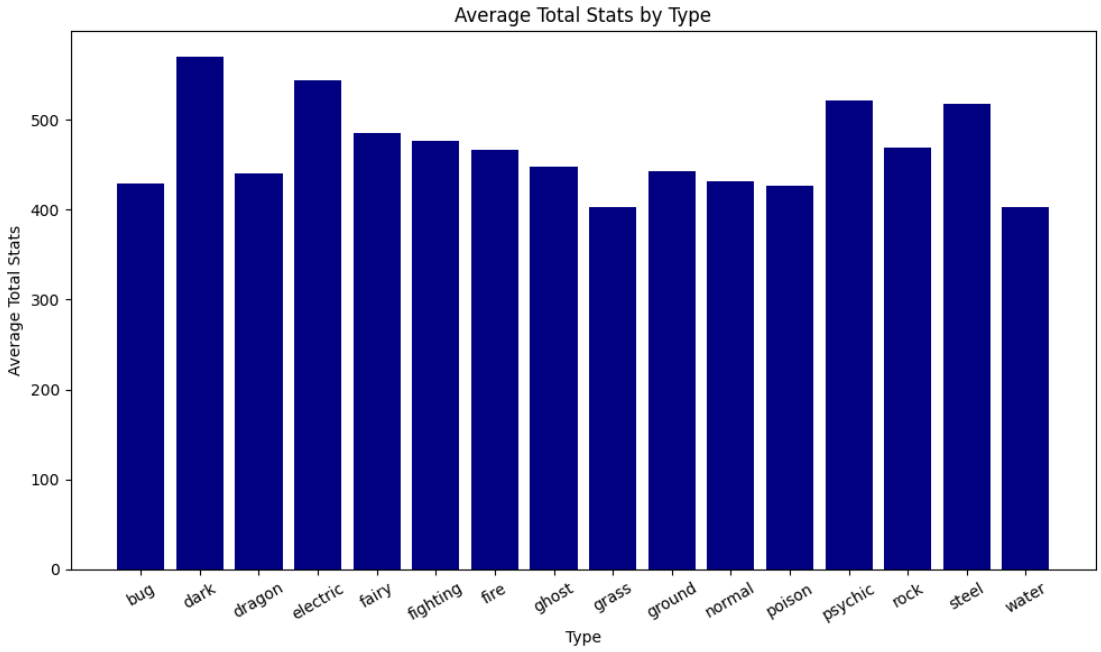
For the Generation 6 (id 650-721), we got the graph 2.1.6:



Graph 2.1.6

In Generation 6, Bug-type and Normal-type Pokémon continued to serve as the typical weaker categories. These Pokémon are often encountered early in a player's journey, making them more accessible but also less powerful in terms of Total Stats. As a result, they retained relatively lower overall stats compared to other types.

For the Generation 7 (id 722-809), we got the graph 2.1.7:

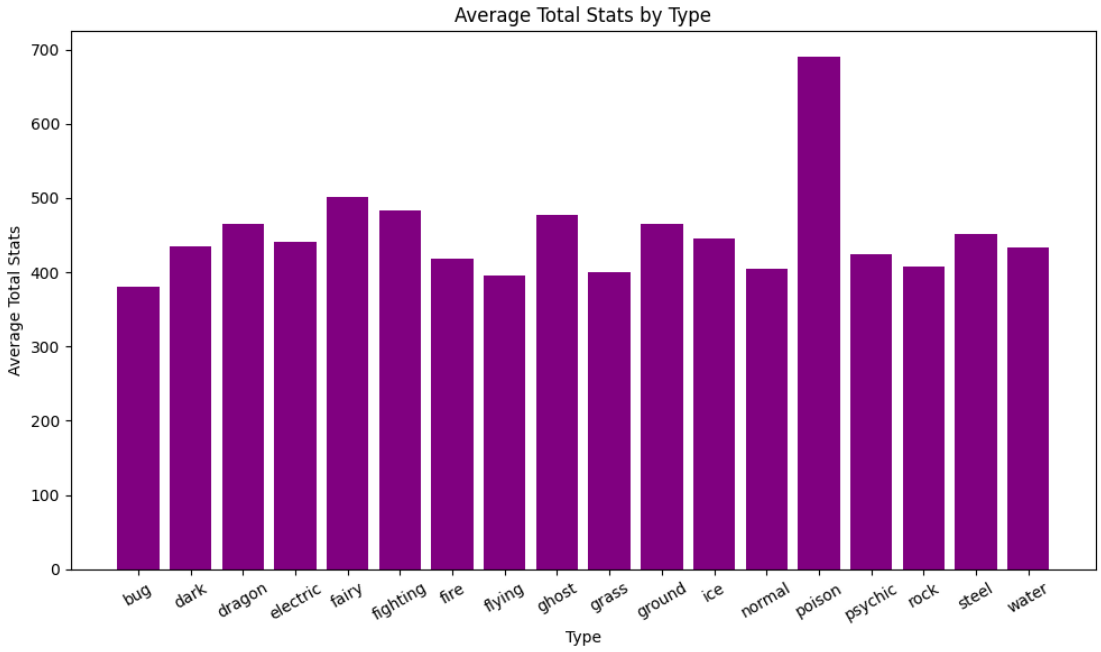


Graph 2.1.7

In Generation 7, more Dark-type Pokémon were introduced as rare or legendary species, continuing the trend of giving this type relatively higher Total Stats.

By contrast, Grass-type Pokémon were noticeably weakened. Since Grass-type Gyms often appear early in the game, these Pokémon tend to be positioned as easier opponents, which may explain their lower stats. However, Grass is also one of the three traditional starter types that every player must choose from at the beginning of their journey. Weakening Grass-types too much risks creating an imbalance, as it diminishes the appeal of one of the core starter options.

For the Generation 8 (id 810-905), we got the graph 2.1.8:

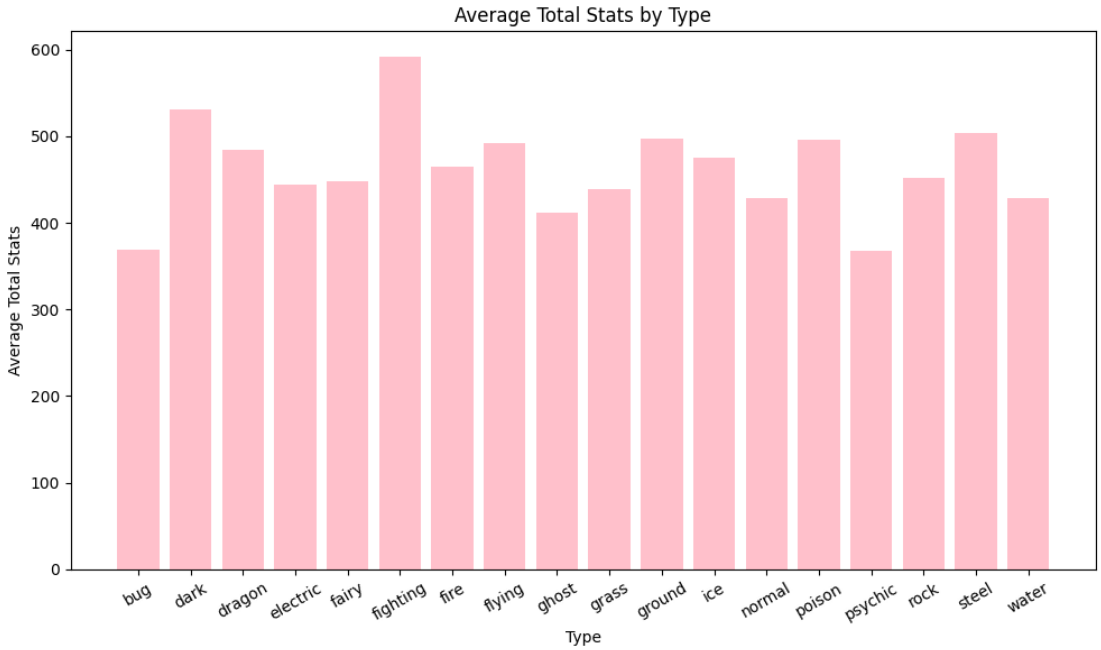


Graph 2.1.8

In Generation 8, most types became relatively well-balanced. However, the introduction of several new Poison-type Pokémon as rare or legendary species disrupted this balance, with some reaching Total Stats close to 700.

Despite this imbalance, the rarity and difficulty of obtaining these powerful Pokémon helped preserve overall game balance. Since only dedicated players could access them, they did not undermine the general competitive environment. At the same time, the presence of exceptionally strong Pokémon served as a marketing strategy, appealing to players who enjoy the thrill of discovering and training rare, overpowered species.

For the Generation 9 (id 906-1025), we got the graph 2.1.9:

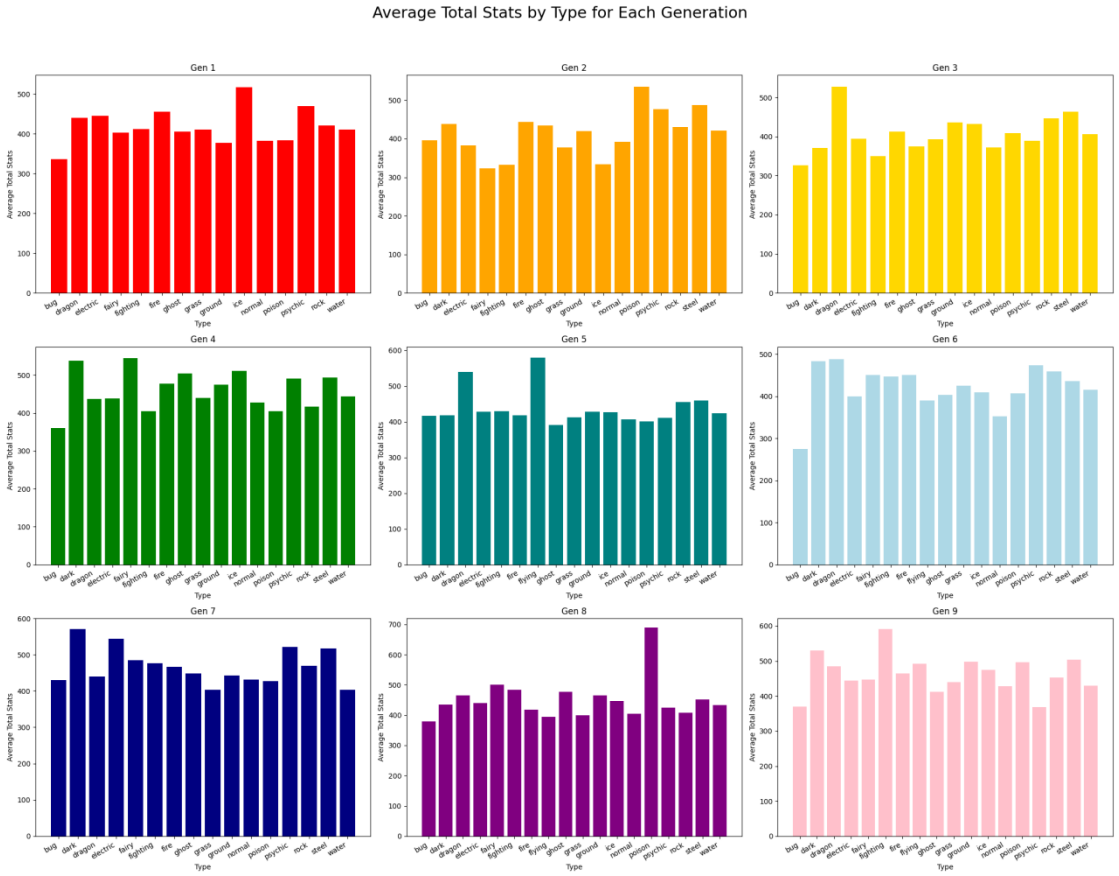


Graph 2.1.9

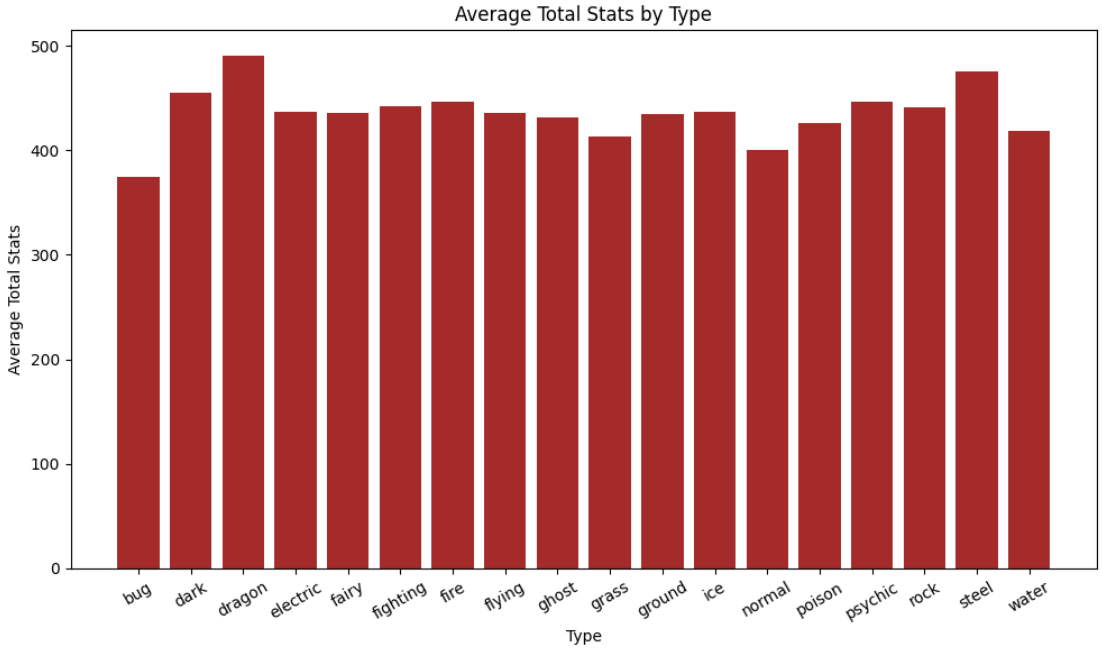
In Generation 9, the Psychic-type Pokémon were generally weakened, while Fighting-types received a noticeable boost.

Overall, the balance among most other types has become increasingly stable compared to earlier generations. Dark, Dragon, Flying, and Steel-types continue to maintain high Total Stats, remaining strong choices for players. Meanwhile, Normal- and Bug-types remain on the weaker side, consistent with their traditional role as early-game or common Pokémon.

When we compare all 9 generation, we got graph 2.1.10. Calculating the average total stats for all the Pokémons and compare them by type, we got graph 2.1.11.



Graph 2.1.10



Graph2.1.11

Across all generations, certain patterns in type strength are clear:

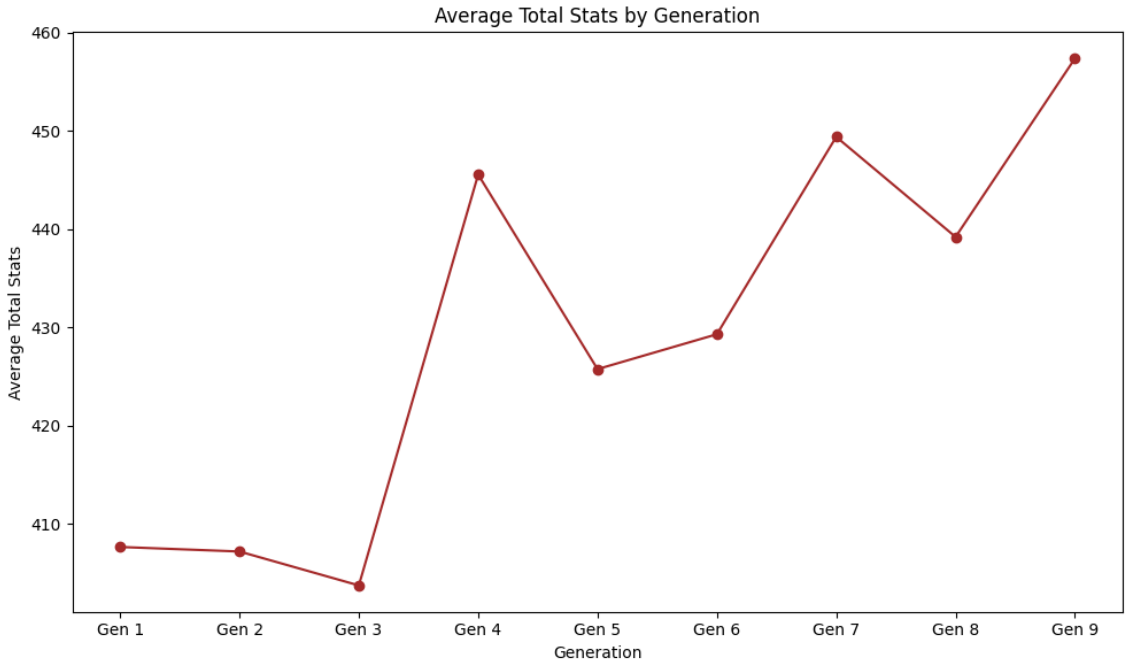
Bug, Normal, and Grass-type Pokémon generally remain weaker than other types. This is largely because they typically appear early in the game. Among these, Grass-types are

slightly stronger, reflecting their status as one of the three starter types that players must choose from at the beginning of their journey.

Dragon-type Pokémon are usually legendary or rare species, and as a result, they consistently possess high Total Stats.

For most other types, the balance has gradually improved over the course of nine generations. While Graph 2.1.10 may not perfectly reflect this balance, the overall trend shows that Pokémon stats have become more equitable across types over time.

Additionally, examining Total Stats by generation reveals a clear trend: newer Pokémon tend to be stronger than their predecessors. This is illustrated in Graph 2.1.12, showing a gradual increase in the average strength of Pokémon across successive generations.

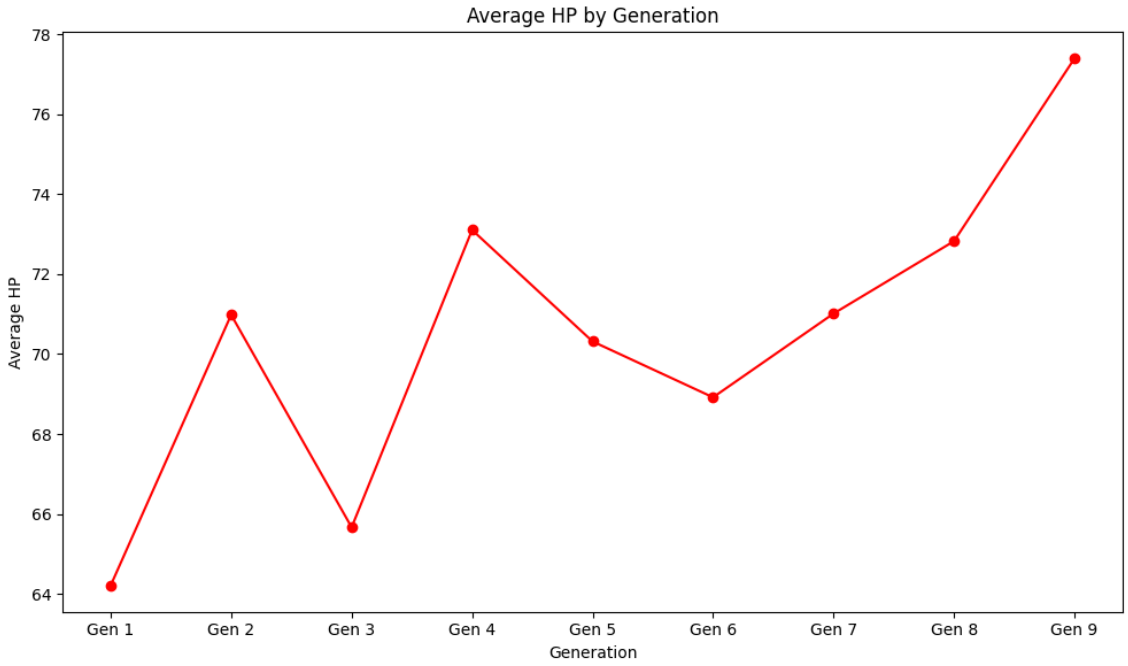


Graph 2.1.12

2.2. Changes in Individual Base Stats

So far, we have examined trends in Total Stats across generations. However, to better understand what drives these changes, it is important to analyse each individual base stat. Which specific stats have increased or decreased over time, and how do they contribute to the overall Total Stats?

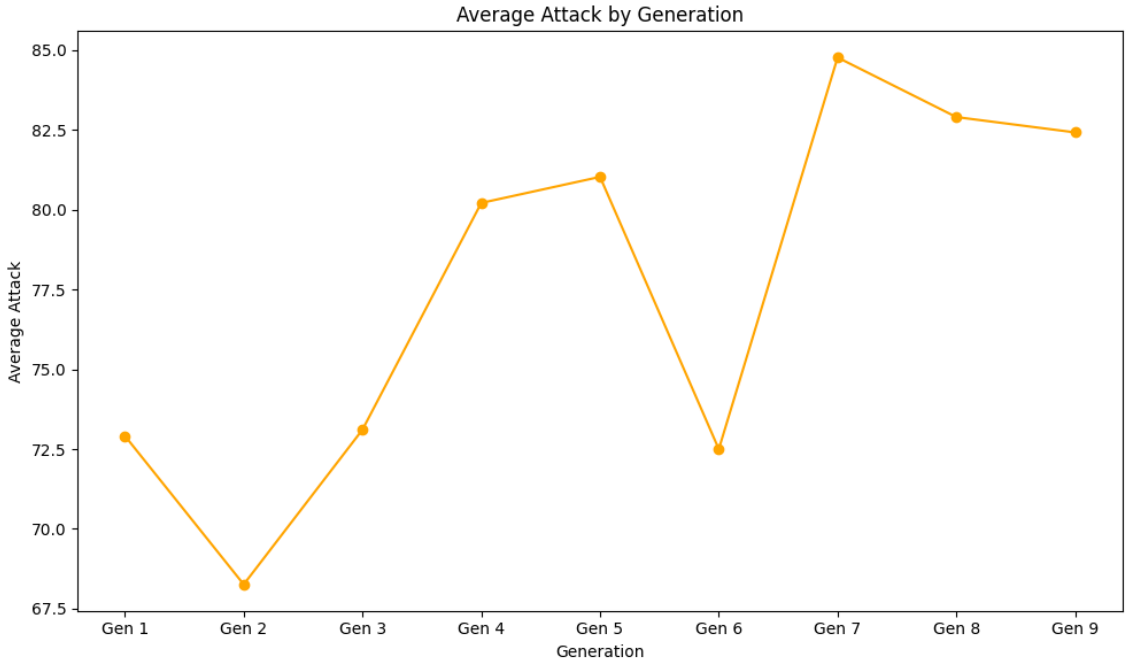
As a first step, we calculated the average HP for each generation, shown in Graph 2.2.1.



Graph 2.2.1

Except the Gen 3, Gen 5 and Gen 6, the Hp of each generation is higher and higher.

Calculating the average Attack for each generation, we got graph 2.2.2:



Graph 2.2.2

Examining Attack across generations reveals some interesting trends:

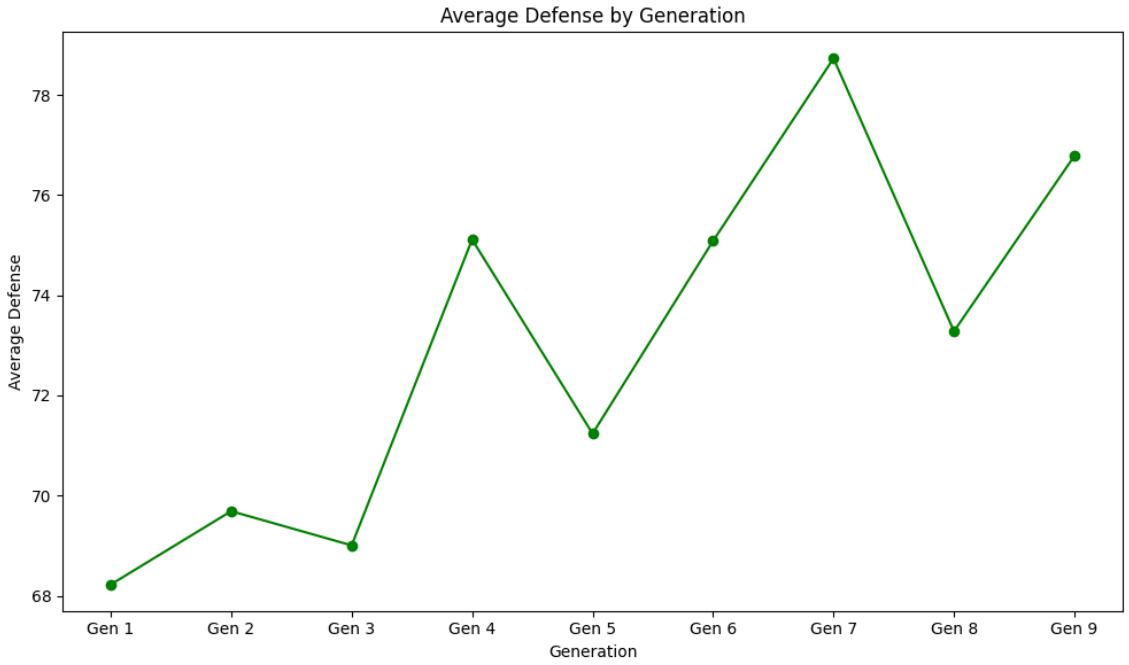
In Generation 2, traditionally high-Attack types such as Fighting, Grass, and Ice had lower Total Stats, which resulted in a noticeable drop in average Attack for that generation.

Similarly, in Generation 6, high-Attack types like Normal, Flying, and Electric experienced lower Total Stats, causing another dip in average Attack.

Conversely, Generation 5 saw Flying-types with higher stats, and Generation 7 featured Electric-types with increased stats. These increases contributed to higher average Attack values in their respective generations.

Overall, the fluctuations in average Attack closely reflect how the designers adjusted stats for specific types across generations.

Calculating the average Defense for each generation, we got graph 2.2.3:

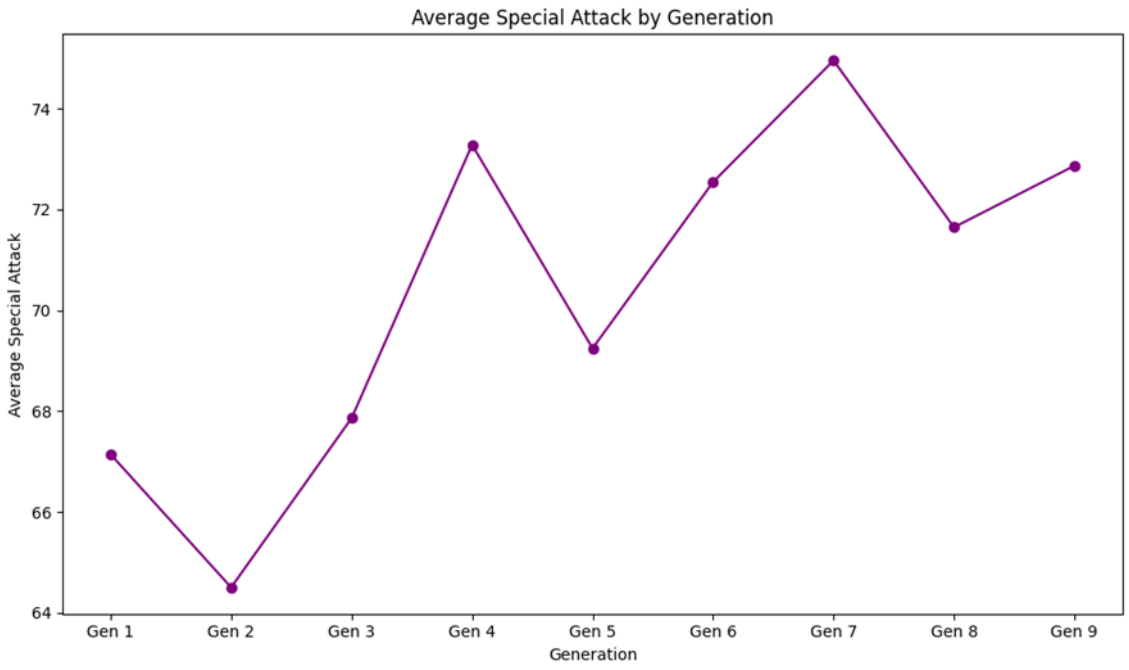


Graph 2.2.3

Overall, Defense has shown a steady increase across generations. Unlike Attack, Defense is less dependent on type, so it tends to grow consistently along with the Total Stats.

A similar trend is observed for Special Attack. Although some variations occur depending on the types emphasized in a generation, the general pattern is a gradual increase in Special Attack values, reflecting the overall growth in Pokémon power over time.

Calculating the average Special Attack for each generation, we got graph 2.2.4:

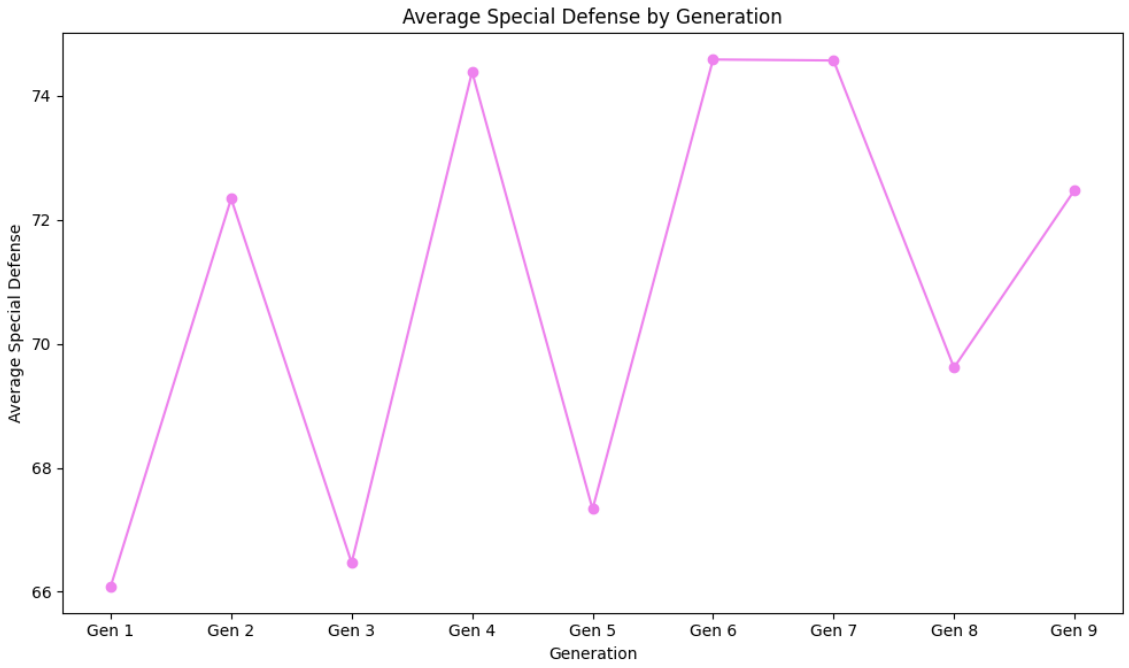


Graph 2.2.4

The trend in Special Attack closely follows the changes in Total Stats. This may be due to the presence of high Special Attack types in every generation, which consistently raises the average.

Another possible factor is the increase in Defense over generations. As physical Defense values grew, some Pokémon may have received higher Special Attack stats to maintain balance in battles, since Special Attack can only be countered by Special Defense. This interplay helps preserve strategic diversity in combat.

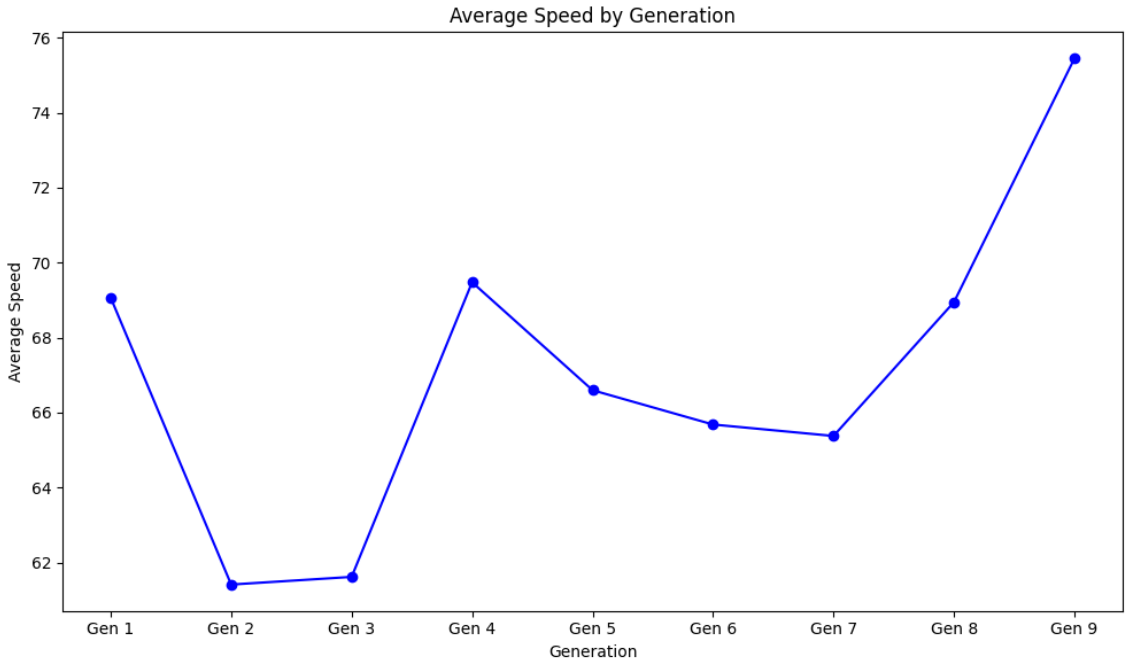
Calculating the average Special Defense for each generation, we got graph 2.2.5:



Graph 2.2.5

The trend for Special Defense is somewhat irregular. In some generations, it follows the overall pattern of Total Stats, increasing alongside other base stats. However, in certain generations, Special Defense appears to be adjusted specifically to counterbalance changes in Special Attack. This suggests that game designers may have deliberately tuned Special Defense values to maintain strategic balance in battles.

Calculating the average Speed for each generation, we got graph 2.2.6:

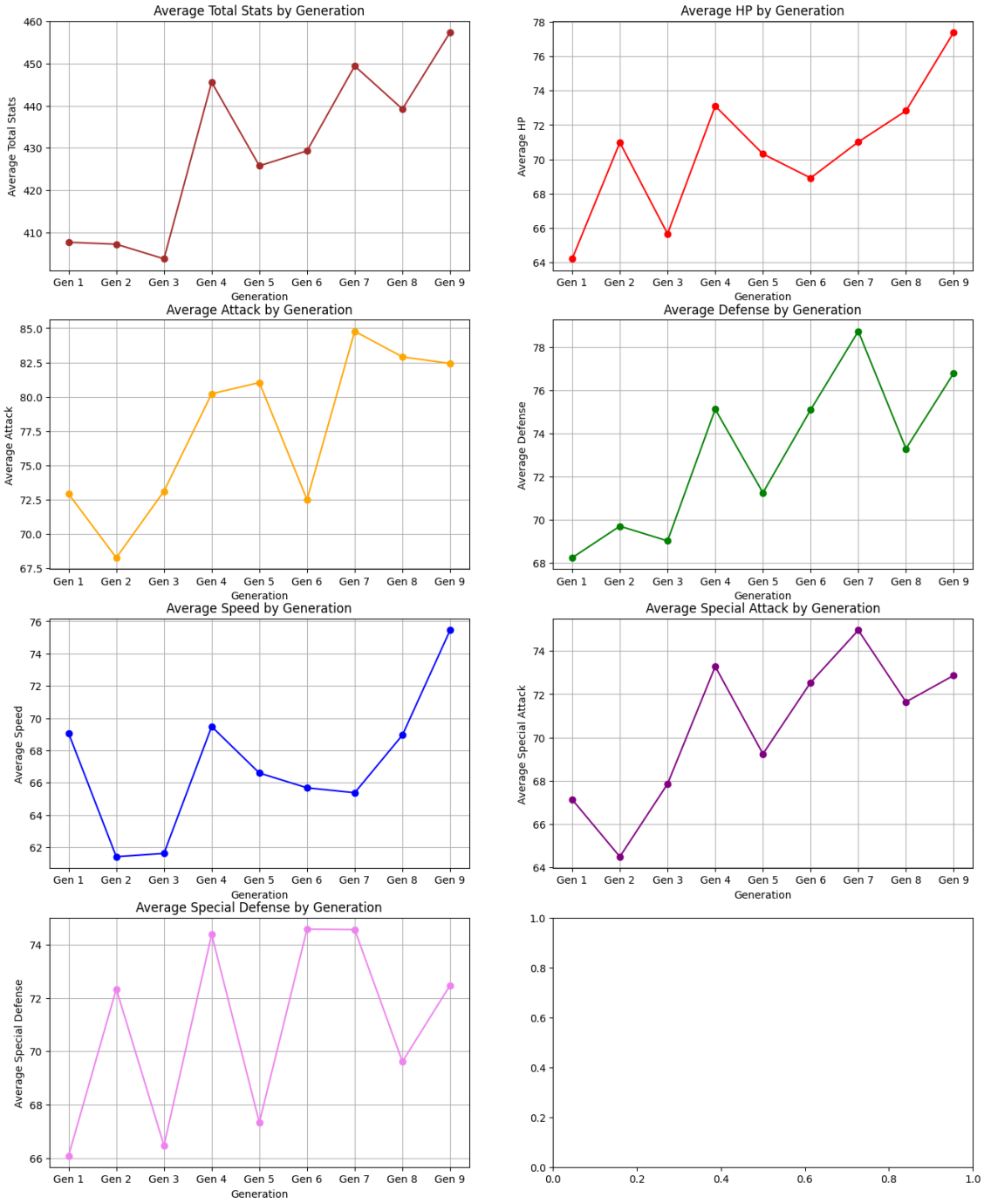


Graph 2.2.6

Speed is a unique stat in Pokémon, as it primarily determines which Pokémon acts first in battle. Acting first can sometimes allow a player to control the flow of combat, but if a Pokémon's Total Stats are fixed, allocating more points to Speed necessarily reduces other base stats.

As a result, Speed often fluctuates across generations in seemingly irregular ways. But if the total stats are fixed, high speed will decrease other base stats. Some players may prioritize overall power over Speed, which could explain why the average Speed values do not follow the consistent upward trends seen in other stats.

When we compare all the base stats, we got the graph 2.2.7:



Graph 2.2.7

As shown in Graph 2.2.7, HP, Defense, and Special Attack generally follow the trends in Total Stats, increasing steadily across generations.

In contrast, Attack, Special Defense, and Speed show more variability. These stats often experience targeted adjustments to maintain battle balance. For example, when other base stats increase, Speed can become a key factor in balancing Total Stats, allowing Pokémon with slightly lower raw power to compete strategically through faster turns in combat.

This analysis highlights that not all stats change uniformly; some are deliberately tuned to preserve gameplay diversity and strategic depth.

3. Is the Total Stats influence the Sales?

If a particular generation has significantly higher or lower Total Stats compared to others, it suggests that Pokémon in that generation are unusually strong or weak relative to the overall average. This raises an important question: Could the perceived strength of Pokémon in a generation influence consumer behavior and game sales?

To explore this, we performed t-tests comparing the average Total Stats across all Pokémon with the Total Stats of each individual generation. The results are as follows:

Gen 1: t-statistic: -2.067810806133753

p-value: 0.03887647579381781

The Gen 1 has significant difference with average ($p<0.05$), the total stats is lower than average.

Gen 2: t-statistic: -1.7361786667063497

p-value: 0.08280650505131222

The Gen 2 has little difference with average ($p<0.1$), the total stats is lower than average.

Gen 3: t-statistic: -2.313913419943714

p-value: 0.020846850972218407

The Gen 3 has significant difference with average ($p<0.05$), the total stats is lower than average.

Gen 4: t-statistic: 1.5550282011006404

p-value: 0.12021936459500224

The Gen 4 has no significant difference with average, the total stats is higher than average.

Gen 5: t-statistic: -0.20150673391461818

p-value: 0.8403371243032907

The Gen 5 has no significant difference with average, the total stats is lower than average.

Gen 6: t-statistic: 0.11780441869562171

p-value: 0.9062442330816304

The Gen 6 has no significant difference with average, the total stats is higher than average.

Gen 7: t-statistic: 1.7262143793245976

p-value: 0.08458686303614948

The Gen 7 has little difference with average ($p<0.1$), the total stats is higher than average.

Gen 8: t-statistic: 0.9555040204618452

p-value: 0.3395292438091897

The Gen 8 has no significant difference with average, the total stats is higher than average.

Gen 9: t-statistic: 2.7203282160692392

p-value: 0.0066206390976074215

The Gen 9 has significant difference with average ($p<0.05$), the total stats is higher than average.

We marked the significant difference as 0, no significant difference as 1, using the Chi-square to compare with Units Sales and Total Sales, we got the result:

The sales did not impact by the total stats. ($p = 0.3423$)

Moreover, because the first generation wouldn't influence by any other generation, we delete the data for first generation and compare again. The sales still did not influence by total stats. ($p = 0.3326$)

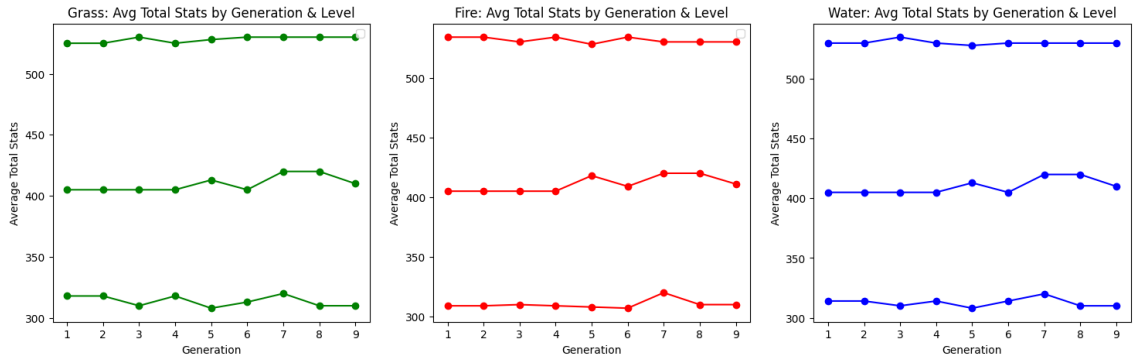
4. Comparing Starter Pokémon: Type Balance Across Generations

4.1. Sampling objects

The three starter Pokémon, also known as the first partner Pokémon, are the initial Pokémon a trainer receives at the beginning of their journey. Players typically choose from three options, each corresponding to one of the Grass, Fire, and Water types. Game designers generally aim to give these starters similar base stats to ensure a fair selection process, making them ideal candidates for studying type balance. For this reason, we selected starter Pokémon as our sampling objects for analysis.

4.2 Starter Pokémon Level Comparison

Every starter Pokémon will evolve three times in every generation, so we compare them by level and type.



Graph 4.2.1

Graph 4.2.1 illustrates the Total Stats for starter Pokémon across all generations:

Green lines represent Grass-type starters.

Red lines represent Fire-type starters.

Blue lines represent Water-type starters.

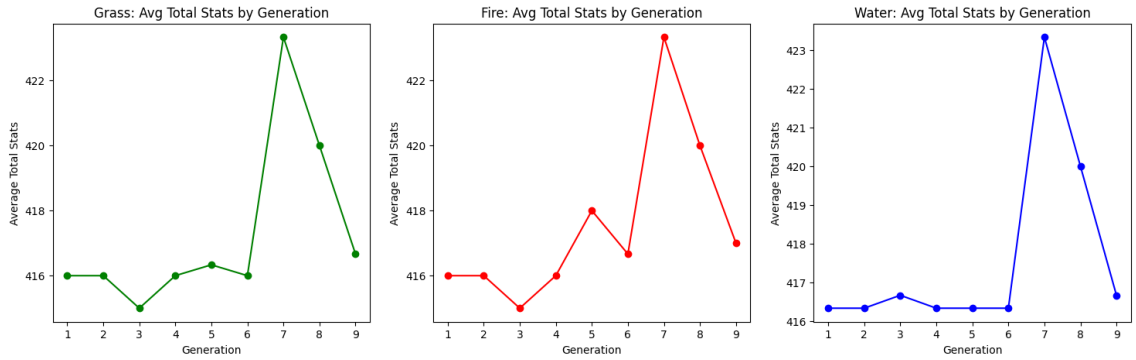
The highest lines correspond to Level 3 (final evolution) Pokémon with the highest Total Stats.

The lowest lines correspond to Level 1 (base form) Pokémon with the lowest Total Stats.

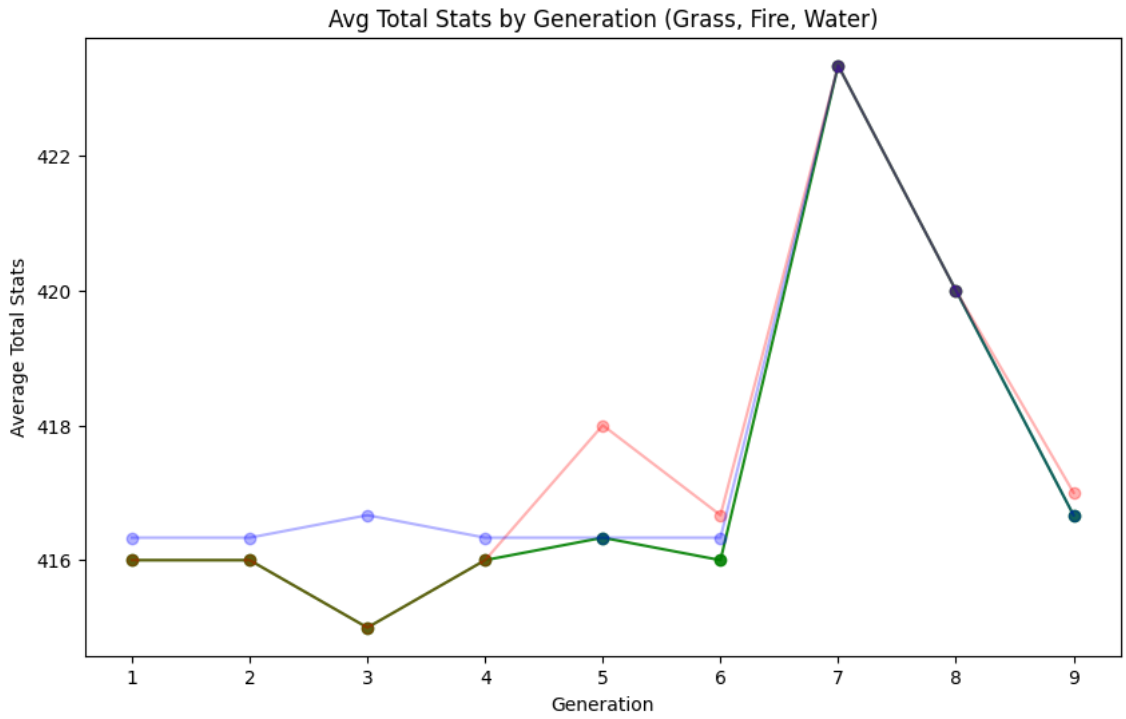
The middle lines correspond to Level 2 (first evolution) Pokémon.

From the graph, we can see that changes in Total Stats are remarkably consistent across types within each generation, particularly for Level 2 Pokémon. This indicates that the game designers maintain a careful balance among starter Pokémon, ensuring fairness regardless of the type selected.

When we calculate the average for three level, we got graph 4.2.2 and graph 4.2.3:



Graph 4.2.2



Graph 4.2.3

Graph 4.2.2 further confirms that the trend of Total Stats changes across generations is similar for all three starter types.

However, Graph 4.2.3 reveals that the balance among the three starter types is not always perfect.

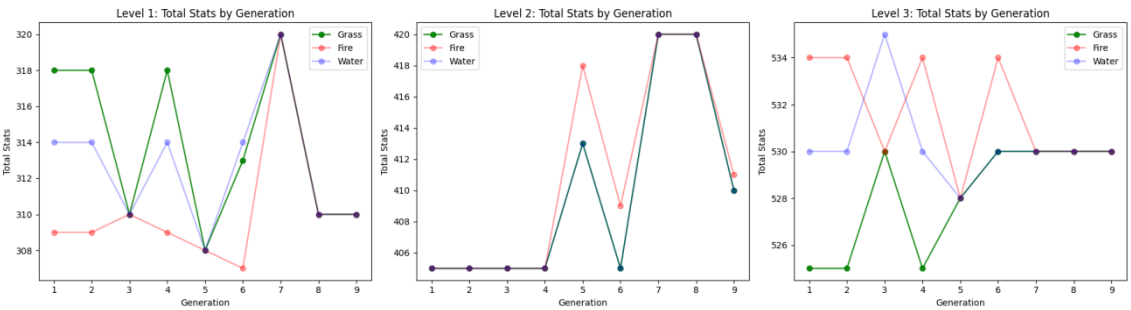
In the early generations, Water-type starters were stronger than the other two types.

By Generation 5, Fire-type starters became the dominant type in terms of Total Stats.

Generations 7 and 8 show a period of near-perfect balance among all starter types.

In Generation 9, Fire-type starters once again emerge as the strongest.

This pattern may help explain player preferences: Fire-type starters are often the most popular, while Grass-type starters tend to be less favored, reflecting their comparatively lower stats in certain generations. (References: https://Pokémon.fandom.com)



Graph 4.2.4

Comparing starter Pokémon by evolution level, type, and generation highlights differences more clearly:

At Level 1, in Generations 1, 2, and 5, Grass-type starters are initially stronger than the other two types. However, by Level 3, they often become the weakest.

Conversely, Fire-type starters tend to start weaker but grow to become the strongest Pokémon at Level 3.

This design creates a gameplay imbalance. Early in the game, players do not require excessively strong Pokémon, but they need stronger Pokémon in later stages as the game becomes more challenging. This imbalance may exacerbate player preference for Fire-type starters and contribute to the lower popularity of Grass-type starters.

By Generations 7–9, designers appear to have addressed this issue: all three starter types have roughly equal Total Stats at Level 1 and Level 3, creating a more balanced and fair experience.

In contrast, during Generations 1–2 and 4–6, the Fire-type starters' advantage at Level 3 was significant enough to influence many players to choose Fire-type Pokémon from the beginning, reinforcing type preference patterns seen in the player base.

5. Conclusion

The Pokémon world is not perfectly balanced, either by type or by generation. Overall, Pokémon have become stronger over time, and the game has gradually become more balanced. However, designers still introduce differences in base stats, even among starter Pokémon.

These variations may reflect a strategic attempt to appeal to the market, influencing player preferences and engagement. However, it appears that players are not strongly influenced by the average Total Stats of an entire generation. Instead, their choices may be affected more by specific Pokémon with distinctive strengths or popular: a dynamic that warrants further exploration in future studies.