Apple Projections
(COMP3125 Individual Project)

Tyler Cornell
Computer Science

I. INTRODUCTION

In this project I will be diving into things regarding Apple products. I look to do this because I am a computer science major and Apple is one of the largest technology companies in the world so Apple is one of the leaders in my field. This makes Apple a great company to dive into and see what their future could potentially look like. Apple keeps track of all their data and makes much of it publicly available. I will be answering all of the following questions by analyzing this data to make a prediction:

What will iPhone revenue look like over the next three years?

What will iPad revenue look like over the next three years?

How many iPhones will Apple sell in the next three years?

How many iPads will Apple sell in the next three years?

If both continue growing at similar rates, in what year could Apple Music surpass Spotify in subscriptions?

II. DATASETS

A. Source of dataset

All of the data used in this project was sourced from Statista. Most of the data that I used from there comes from Apple themselves but was put in Statista in a way that makes it easy to search for as well as giving users many of ways in which you can download the data for yourself and same goes for the one dataset I used from Spotify. I downloaded excel sheets for each of these data sets that I used. This project took a total of six sources. I looked for data that is close to the present day so data for projections could be as accurate as possible. The data for iPhone revenue, iPad revenue, and Spotify Premium subscriptions were all updated through 2024. Apple Music subscriptions and iPad unit sales were updated through 2023. Unfortunately, the most recent dataset for iPhone unit sales is from 2018.

B. Character of the datasets

Since I am looking to make projections time is crucial so all of these datasets contain a column with some sort of timestamp along with its corresponding data. The first dataset [1] I worked with was iPhone revenue, which consisted of quarters from Q3 from 2007 to Q4 2024 and revenue in millions of dollars. This dataset contained all information and did not require any cleaning. The second dataset [2] I worked with was for iPad revenue. Similar to iPhone it consisted of quarter and revenue in millions but this one starts in Q3 2010 to Q4 2024. As for the third dataset [3] I worked with, iPhone units sold it contains quarters starting from Q3 2007 to Q4 2018 and units in millions. My goal was to create projections through 2027 so it only having data through 2018 made it so my data wouldn't be as accurate as possible because I had to do projections from 2019 through 2027. The fourth dataset [4]

I worked with was iPad units sold. This dataset was provides the year and the units sold in millions, spanning from 2011 to 2023 and since I wanted to do projections through 2027 this would require doing four years and using a different method because it is in years instead of quarters like the others. My final question required two datasets: Spotify Premium subscriptions and Apple Music subscriptions. For Spotify the data [5] provided is quarters from Q1 2015 to Q2 2024 along with subscriptions in millions. As for Apple Music subscriptions I was able to obtain data [6] containing months from October 2015 to June 2023 and subscriptions in millions. However, for the months it did not provide each month through the whole span, so I had to do some cleaning to this data. I went in and removed every row that wasn't in June from 2016 to 2023 because June was the month that occurred the most and the only one provided after 2019. There was one year in the 2016 to 2023 range that didn't include June so I decided to go with the data from May in 2018 as it was closest to June and give me some somewhat consistent data from each year from 2016 to 2023.

III. METHODOLOGY

A. Holt-Winter's Seasonal Smoothing

This method is a time series method that takes into account the data as it has changed over time and puts an emphasis on the more recent data when making a forecast. I used the additive method which doesn't take into account of the seasons as much as the multiplicative method because there wasn't a clear difference between the quarters. The formulas of this are as follows.

$$s_0 = x_0$$
$$s_t = \alpha\left(\frac{x_t}{c_{t-L}}\right) + (1-\alpha)(s_{t-1} + b_{t-1})$$
$$b_t = \beta(s_t - s_{t-1}) + (1-\beta)b_{t-1}$$
$$c_t = \frac{\gamma x_t}{s_t} + (1-\gamma)c_{t-L}$$

s_t represents the smoothed statistic which means it's the weighted average of the current observation of Yt. s_{t-1} is the previous smoothed statistic. α is the smoothing factor of the data that is between 0 and 1. t is the time period. b_t stands for the best estimate of a trend at time(t). β represents the trend smoothing factor which is between 0 and 1. c_t is for the seasonal component at time t. γ represents the seasonal smoothing parameter between 0 and 1.

Equation and variable explanation from geeksforgeeks [7]

I was able to use the python library of statmodels to get the function ExponentialSmoothing to use the Holt-Winter's Seasonal Smoothing. With this method I just had to pass the dataset through the function as well as the seasonal_period which I set to 4 because I am working with quarterly data, I also passed trend through which I set to add because I used

the additive method, and finally I passed seasonal through which I set to add which indicates that there is additive seasonal effect which gives a fixed amount of value added at each time step because based of historical data each quarter doesn't represent a significant affect. I was then able to fit the model from the ExponentialSmoothing function to my data then able to make a forecast by doing .forecast() and the number I entered in the parentheses would be how many quarters it would forecast. So this method method was used for my question about iPhone and iPad revenue which I forecasted 12 quarters to reach the end 2027 since the last data point was in the end 2024. I used this method as well to answer iPhone units question but I had to forecast 36 time steps because the last data point was in 2018 Q4 so 36 quarters is 9 years which brings the forecast until the end of 2027. Finally this method was also used for the Spotify Premium subscription part where I forecasted 202 quarters because I wanted to see Apple Music would ever catch up with Spotify so I determined 50 years would be a large enough sample size because the landscape of streaming could be vastly different by then and I did the extra two quarters so I could reach the end of 2074 since I had data up until 2024 Q2. With this method I was able to come up with an idea of what all these would look like while closely following its historical patterns because it is a triple exponential function.

B. Double Exponential Smoothing

This method is similar to Holt's Winter Exponential Smoothing but does not account for seasonal patterns and gives a linear trend. I use this method because not all the data used was quarterly and, in this case, I used this method for yearly data. The equations for the Double Exponential Smoothing method are as follows:

$$s_t = \alpha x_t + (1 - \alpha)(s_{t-1} + b_{t-1})$$
$$\beta_t = \beta(s_t - s_{t-1}) + (1 - \beta)b_{t-1}$$

All variables here are the same as defined in the Holt-Winters' Exponential Smoothing section.

Equation and variable explanation from geeksforgeeks [7]

I was able to use the same statmodels library but this time I used it to get the Holt function. With this method, since there aren't any seasons to take into consideration, I could just pass my data into the Holt function, then fit it to my data and make a forecast. I used this method to answer my question about iPad units by forecasting four years since I wanted to what the numbers would look like three years from today, so this brings me to the end of 2027 since the data had only gone up to the end of 2023. I also used this method for the portion where I wanted to see Apple Music subscribers and was able to forecast 51 years in the future so I could have results up until the end of 2074 as I did for Spotify. This method gave me linear results to do accurate forecasts so I could easily answer my questions.

IV. RESULTS

A. What will iPhone revenue look like over the next three years?

After running my code and printing the dataframe with the forecast I found Apple will continually produce outperform their revenue from a year ago for each quarter and gradually grow in their cell phone sector over the next 3 years as seen in "Fig. 1".

Quarter	Projected Revenue of iPhones (USD in Millions)
Q1 '25	70577.10
Q2 '25	50788.14
Q3 '25	43541.39
Q4 '25	46623.14
Q1 '26	73166.58
Q2 '26	53377.62
Q3 '26	46130.87
Q4 '26	49212.62
Q1 '27	75756.07
Q2 '27	55967.10
Q3 '27	48720.35
Q4 '27	51802.10

Fig. 1. Data produced as a result of Holt-Winters' Exponential Smoothing shows the amount of projected revenue being brought in from Apple's iPhone in millions of US dollars for each of the corresponding quarters.

B. What will iPad revenue look like over the next three years?

As a result of passing all iPad revenue from 2010 to 2024 into Holt-Winters' Exponential Smoothing function, I found Apple will continue to grow and outperform each quarter from the year before over the next three years as seen in "Fig. 2.".

Quarter	Projected Revenue of iPads (USD in Millions)
Q1 '25	8268.39
Q2 '25	6879.92
Q3 '25	7163.06
Q4 '25	6950.83
Q1 '26	8470.86
Q2 '26	7082.40
Q3 '26	7365.54
Q4 '26	7153.30
Q1 '27	8673.34
Q2 '27	7284.88
Q3 '27	7568.02
Q4 '27	7355.79

Fig. 2. Data produced as a result of Holt-Winters' Exponential Smoothing shows the projected amount of revenue being brought in from Apple's iPad in millions of US dollars for each of the corresponding quarters.

C. How many iPhones will Apple sell in the next three years?

The results of passing Apple's data of the number of iPhones sold into the Holt-Winters Exponential function were used to produce the figure below, "Fig. 3.". Here I can see that Apple will continue to outperform the quarter from the year before and continue to sell more and more each year. This makes sense because in part A of the results, I had also predicted the same would happen to the revenue that Apple is bringing in for the iPhone.

Quarter	Projected Number of iPhones Sold (in Millions)
Q1 '25	108.30
Q2 '25	83.44
Q3 '25	73.89
Q4 '25	82.03
Q1 '26	113.11
Q2 '26	88.25
Q3 '26	78.70
Q4 '26	86.84
Q1 '27	117.93
Q2 '27	93.07
Q3 '27	83.51

Q4 '27	91.65

Fig. 3. Data produced as a result of Holt-Winters' Exponential Smoothing shows the amount of iPhone units projected to be sold by Apple in millions from quarterly sales in 2025 to 2027.

D. How many iPads will Apple sell in the next three years?

After using the Double Exponential Smoothing function on Apple's data from iPads I was able to produce the figure below, "Fig. 4.". The results that can be seen show that over the next three years, Apple will continue to sell more iPads each year which makes sense since in part B of the results section I had predicted that Apple would bring in more revenue than the previous year for the next three years.

Year	Number of iPads Sold (in Millions)
2025	10.54
2026	11.29
2027	12.03

Fig. 4. Data produced as a result of Double Exponential Smoothing shows the amount of iPad units projected to be sold by Apple in millions from sales in 2025 to 2027.

E. If both continue growing at similar rates, in what year could Apple Music surpass Spotify in subscriptions?

After running both Spotify and Apple's data through Holt-Winter's Exponential Smoothing and Double Exponential Smoothing respectively I compared Spotify's Q2 data with Apple's Yearly data because Apple's data is from June which aligns with the end of Q2. Then I used matplotlib to produce a line graph, "Fig. 5", to display the difference in the number of subscribers by subtracting Apple from Spotify because Spotify was noticeably larger to begin with. I compared the next 50 years because I feel like after that time, or even sooner, streaming could look very different. After seeing the graph it is clear that Spotify is likely holding on to the top spot while Apple Music continues to trail by a large margin.
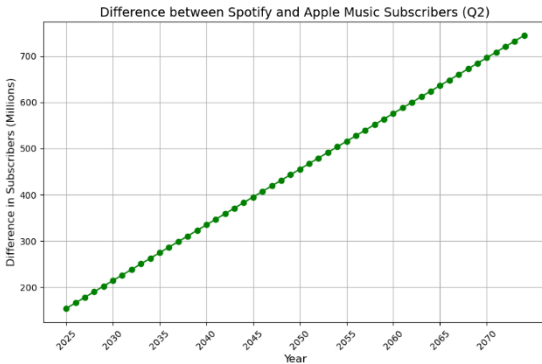

Fig. 5. Data produced as a result of the difference in Spotify Premium subscriptions minus Apple Music subscriptions forecast (in millions) at the end of quarter two of each year created via matplotlib library

V. DISCUSSION

One of the things that could have been useful was having even more frequent timestamps for each of the datasets. For example, I only had access to quarterly data at best but if I had monthly data I could probably come up with more accurate projections. Another thing that could have been done to improve the result of this project is to use more than one method for each of the questions to try to come up with an even better solution.

VI. CONCLUSION

With this project, I was able to conclude that Apple will likely continue to grow as a company. I was able to see that they will continue to sell more iPhones and iPads than they have in the past if their current trajectory does not change. Apple will continue to be one of the largest companies in the world and dominate its competitors when it comes to handheld devices. As for their Apple Music service, it will likely grow larger but will stay significantly behind Spotify, which seems to have the largest audio streaming platform.

REFERENCES

[1] Apple. "Apple's Iphone Revenue from 3rd Quarter 2007 to 4th Quarter 2024 (in Million U.S. Dollars)." *Statista*, Statista Inc., 31 Oct 2024, https://www.statista.com/statistics/263402/apples-iphone-revenue-since-3rd-quarter-2007/

[2] Apple. "Revenue of Apple from Ipad Sales Worldwide from 3rd Quarter 2010 to 4th Quarter 2024 (in Million U.S. Dollars)." *Statista*, Statista Inc., 31 Oct 2024, https://www.statista.com/statistics/269914/apples-global-revenue-from-ipad-sales-by-quarter/

[3] Apple. "Global Apple Iphone Sales from 3rd Quarter 2007 to 4th Quarter 2018 (in Million Units)*." *Statista*, Statista Inc., 1 Nov 2018, https://www.statista.com/statistics/263401/global-apple-iphone-sales-since-3rd-quarter-2007/

[4] Business of Apps. "Unit Sales of The Apple Ipad from 2011 to 2023 (in Millions)." *Statista*, Statista Inc., 10 Sep 2024, https://www.statista.com/statistics/1421547/apple-ipad-unit-sales/

[5] Spotify. "Number of Spotify Premium Subscribers Worldwide from 1st Quarter 2015 to 3rd Quarter of 2024 (in Millions)." *Statista*, Statista Inc., 12 Nov 2024, https://www.statista.com/statistics/244995/number-of-paying-spotify-subscribers/

[6] Business of Apps. "Number of Apple Music Subscribers Worldwide from October 2015 to June 2023 (in Millions)." *Statista*, Statista Inc., 7 May 2024, https://www.statista.com/statistics/604959/number-of-apple-music-subscribers/

[7] "Exponential Smoothing for Time Series Forecasting." GeeksforGeeks, GeeksforGeeks, 27 May 2024, www.geeksforgeeks.org/exponential-smoothing-for-time-series-forecasting/.