MARKETING RESEARCH
CUSTOMER SATISFACTION

AirPods Satisfaction Survey

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Contents

Executive Summary

Apple AirPods are wireless earphones manufactured by Apple. When the AirPods were first introduced in 2016, they were considered the highest level of satisfaction for a new product from Apple, with 98% of customers said they were very satisfied or satisfied[1] with the product. In this report, I conducted a survey to explore customers' satisfaction level with Apple AirPods on different features. The findings from 89 respondents in Durham, North Carolina, show that 97.7% of customers said they were completely satisfied, very satisfied, or satisfied with the products, which is quite the same as the abovementioned survey result. Especially, the Design received the highest satisfaction level of the AirPods from our sample, with 94.4% of respondents said they were completely satisfied, very satisfied, or satisfied with the Design of the device. Our analysis also recommends that Apple improve battery life, secure fit in-ear, and sound quality, since they are the most important feature from the user's point of view; however, the level of satisfaction for these features is relatively low.

A. Industry background

In our report, the headphones market includes on-ear headphones, earbud headphones, and over-ear headphones. As of December 2020, under the impact of COVID-19, the US market's market size is $2,023bn with 145.34 million units. US headphones market has a consistent growth in the last six years, with a CAGR of 4.5% before decreasing in 2020. However, it is projected to continue the growth in 2021 at a rate with the 5Y CAGR of 4.9%[2]. Details on the US headphones market in value and units are in Figure 1 and 2 below.

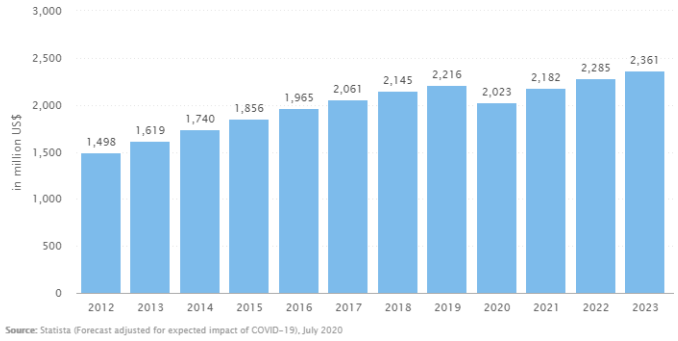


Figure 1: US headphone market – by value ($m)

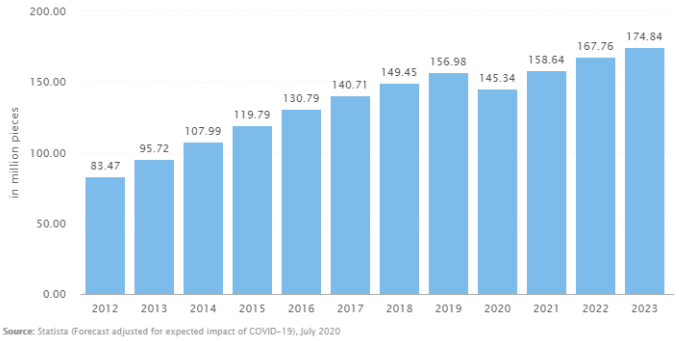


Figure 2: US headphone market – by million pieces

Wireless headphones have a market share of 14% among the total headphones market and are projected to have a faster growth with the 5Y CAGR of 20%. Among the wireless headphones, Apple is currently the market leader with a 60% market share, way ahead of the competition. The rest of the market is quite fragmented with many other players[3]. Major players include Jabra's Elite Active 65t by Jabra, Samsung's Gear by Samsung, Jlab's Jbugds Air by Jlab. Market-share of the market is illustrated in Figure 3.

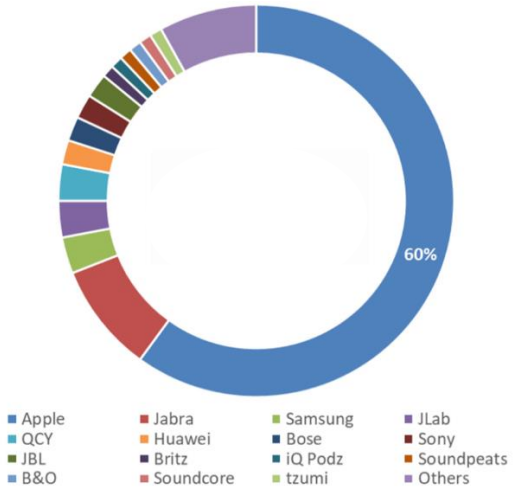


Figure 3: Market-share of wireless headphones.

Headphones market is relatively interesting, with 53% of millennials owned at least 3 pairs of headphones, and 73% admitted that they used headphones to avoid interacting with others.

In catching up with the increasing trend in fitness tracking, headphones manufacturers are developing products that are equipped with fitness tracking and monitoring features. In 2018, Bose first introduced SoundSport Pulse, wireless headphones with a heart rate sensor to create a stable and comfortable fit that can also track the consumers' heart rates during the workout session.

B. Company background

Apple AirPods is a product of Apple, an American technology company headquartered in Cupertino, California. The company is considered one of the Big tech companies and ranks #4 in the Fortune 500 company as of December 2020. In 2018, Apple was the first company to reach a trillion-dollar market capitalization. 60% of the revenues of the company come from outside the US. The company offers a wide range of products: iPhone (accounts for 60% of the company's total revenue; services such as App Store, iCloud, Apple Music, Apple Pay (accounts for 15% of total revenue) and hardware products such as iPad, Mac desktop and notebooks accounts for 10% of total revenue, the rest of the revenue comes from wearables (Apple Watch, AirPods) and other products (HomePod)

Apple's total revenue and income in the last five years are illustrated in Figures 4 and 5[5].

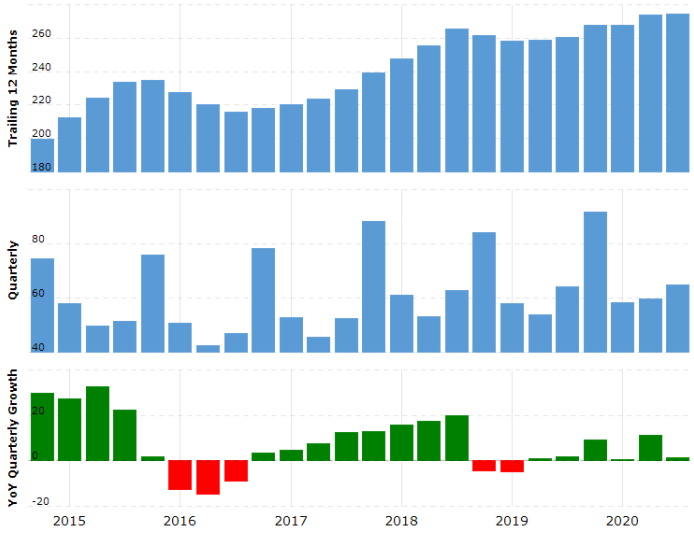


Figure 4: Apple's revenue 2015-2020

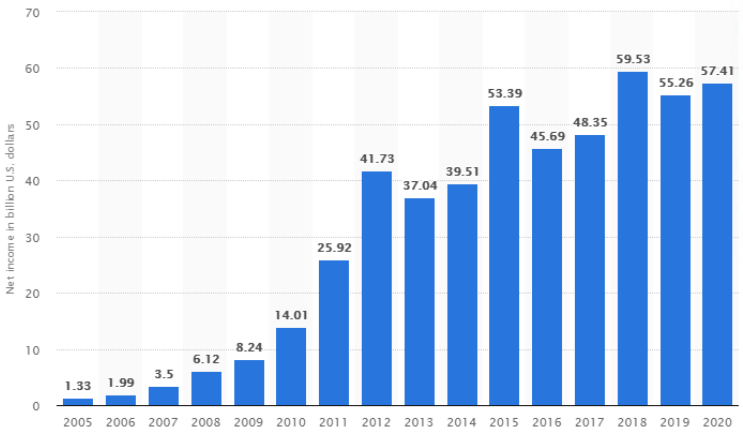


Figure 5: Apple's net income 2005-2020

I have identified Apple's strengths, weaknesses, opportunities, and threats as below:

Strengths	Weaknesses
• Strong reputation/ brand image • Technological Innovation • Good financial health • Perceived as high-quality products • Loyal customer base	• Highly dependent on iPhone • High priced products • Market focused on high-end segments • Limited distribution network
Opportunities	**Threats**
• Expand distribution network • Increasing demand due to rising income per capita • Development of AI	• Risks associated with US-China trade war • Increasing rivalry • Lawsuits

With a wide range of products, Apple has strong competition for each product line. To name a few, some of the major competitors for each product line is in the below table:

iPhone	iPad	PC & Laptop	Wearables
• Samsung • Huawei • Oppo • …	• Samsung • Asus • Google • Amazon Kindle Fire • …	• Samsung • HP • Dell • Lenovo • …	• Xiaomi • Samsung • Huawei • Fitbit • …

Apple's customers are relatively young and have medium to high income. The average household income of Apple's customers is 99k, relatively higher than the average household income in the US[6,7]

US young consumers also show an interest in Apple products. When asked, 1 in 4 people in 18-34 age shows a strong interest in buying any Apple product at any point in the next six months[6,7].

The company also possesses a strong, loyal customer base: 54% of consumers who purchase an iPhone also have an iPhone as their last phone.

Apple consumers are strongly affected by their social relationships: 25% of customers purchased Apple products just because their friends had one.

C. Apple AirPods

The product was first launched in 2016 and is the second best-selling product within two years of launch[5]. Unit sales of AirPods are illustrated in figure 6.

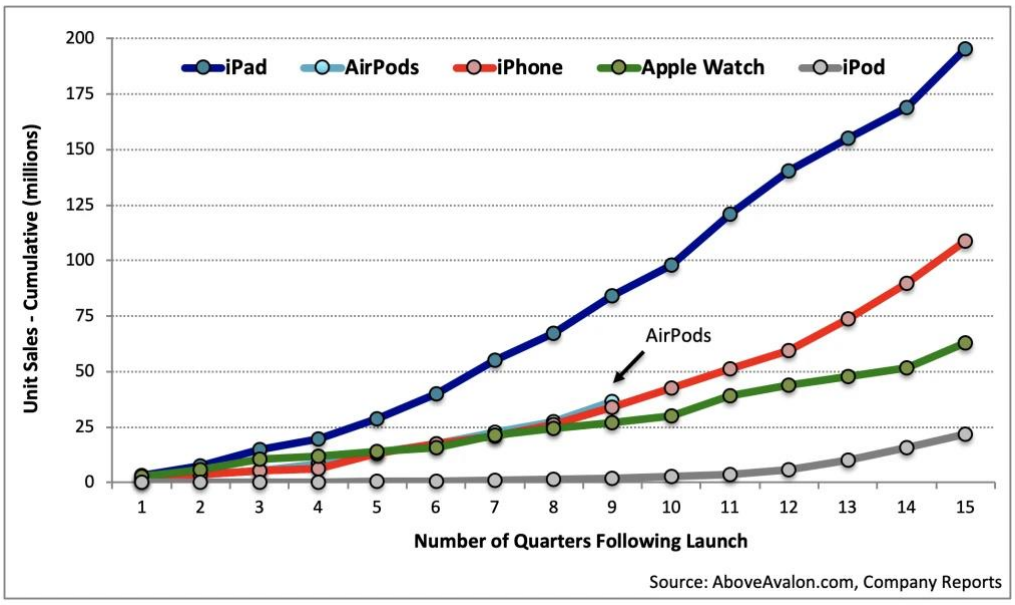


Figure 6: Performance of Apply products after launch

A pair of AirPods costs from $109 to $199, a high-end price in the headphone market. Despite highly-priced, AirPods' revenue increased 50% annually. In 2020, Apple forecasts to sell more than 82 million AirPods, a growth from 61 million units as of last year. But Apple is reportedly losing market share compared to other wireless earbuds brands from Samsung and Xiaomi (decreased from 50%[8] to 35% of true wireless earphones market).

Besides playing audio, Apple AirPods feature a built-in microphone that can filter background noise, allowing users to take phone calls and talking to Siri. AirPods holds a charge of around 5 hours. The device is compatible with any device that supports Bluetooth 4.0, including Android devices. The latest Pro version offers additional high-end functions like water resistance and noise cancellation.

When being launched, the majority of AirPods customers were male. When we take a closer look, the data shows that males buyers are relatively younger than females. Buyers by generations by Gender are illustrated in figure 7.

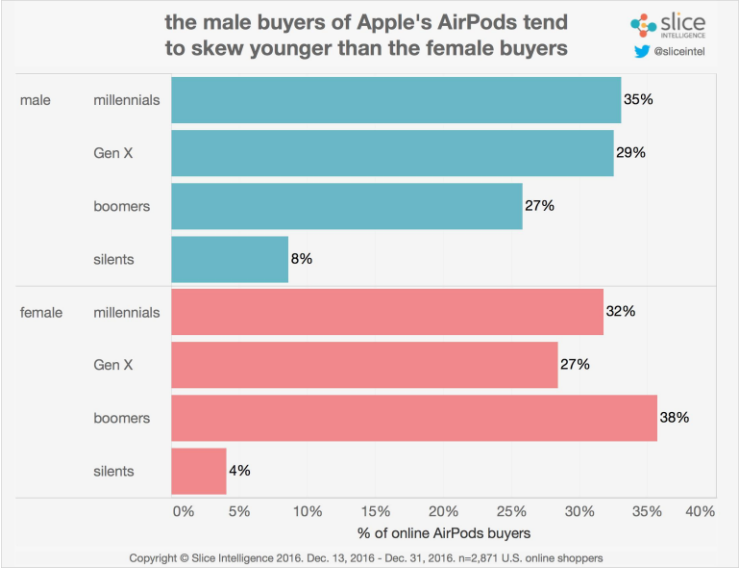


Figure 7: AirPods buyers after launch – by Gender by generation

AirPods' high satisfaction from customers is demonstrated by the fact that there is only 1% of the customers who lost AirPods say they won't replace the accessories[9]. It is estimated that people spend more than $500m every year to replace the lost AirPods.

Despite being the wireless headphone segment's market leader and being preferred for ease of use, comfort, and portability, AirPods are not highly perceived for high sound quality[10].

D. Survey analysis

In Part 1, I went through the statistics regarding the industry, Apple, and AirPods. In this article, I will focus on a more technical analysis of my survey data to help us understand how customers are satisfied with their AirPods.

1. Objectives

The survey was conducted to identify the satisfaction level towards Apple AirPods among college students in Durham city. In our assessment, we also identify the demographics of AirPods users within the Durham area, the frequency of using the devices, activities they perform while using devices, and the features that these respondents consider important during their use of the device. By analyzing the respondents' answers, we'd be able to provide insights on the correlations of the important features and the current satisfactory level. We aim to provide recommendations for the manufacturers to improve some of the features resulting from the analysis.

2. Survey implementation process

- Methodology: Email survey to a selected group (college students in Durham city). The survey link comprised of questionnaires was sent to the group by email.

- Process:

- Questions design
- Sample selection and justification
- Implementation
- Data Collection and Analysis
- Review and Control

- Survey structure:

- Part 1: Diagnostic questions
- Part 2: Satisfaction questions
- Part 3: Demographics

3. Survey data understanding

The survey output was converted into a dataset that can be used for further analysis in this report. A template of this survey can be found here. The resulted dataset includes 89 observations (for each survey response) and 41 columns (for each survey question).

4. Results analysis

a. Demographics

During the survey period, we were able to collect data from 89 respondents. The survey data implies that young people are the dominant age group using AirPods: 60% of people from 18-25 and 34% from 26 to 35. This is reasonable if we look further at the demographic analysis, which shows the dominance of full-time college students at 75%. Other findings worth mentioned are: males are slightly more involved in the survey than females; graduate students double undergraduate students in quantity; and 100% of the selected group has a business major.

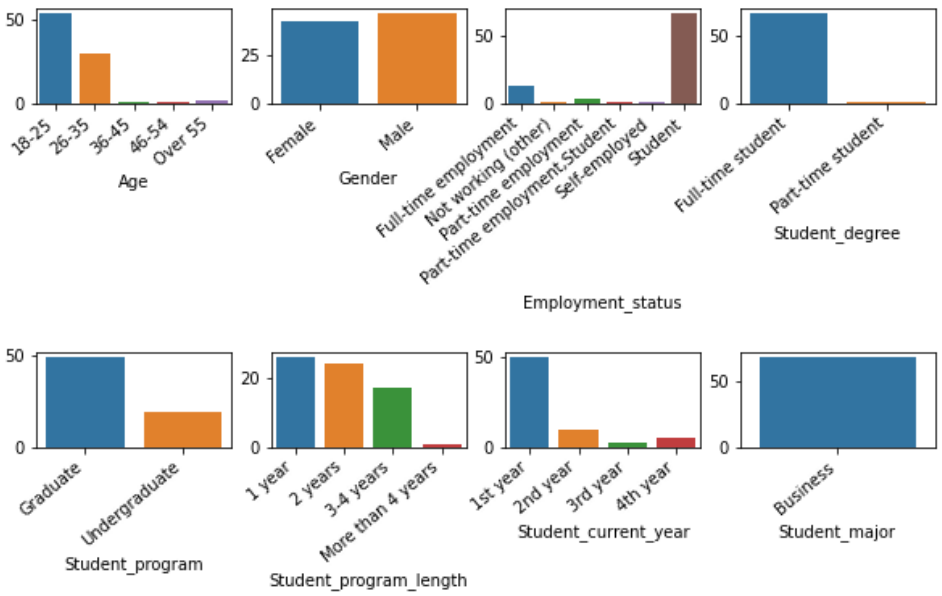


Figure 8: AirPods users age groups and their demographic features

b. Behaviors analysis

- iPhone and AirPods model popularity: Although AirPods can work with non-Apple products, most AirPods users are iPhone owners – 95%. Even when Apple launched their newest third generation for this product line called AirPods Pro more than a year ago, the survey data suggests the extensive coverage of the first generation among their loyal customers, 43% of respondents, followed by the second generation at 38%. AirPods Pro, meanwhile, is used by only 19% of respondents. Another explanation is that over 75% of AirPods users purchased their products years ago when the first generation was introduced.

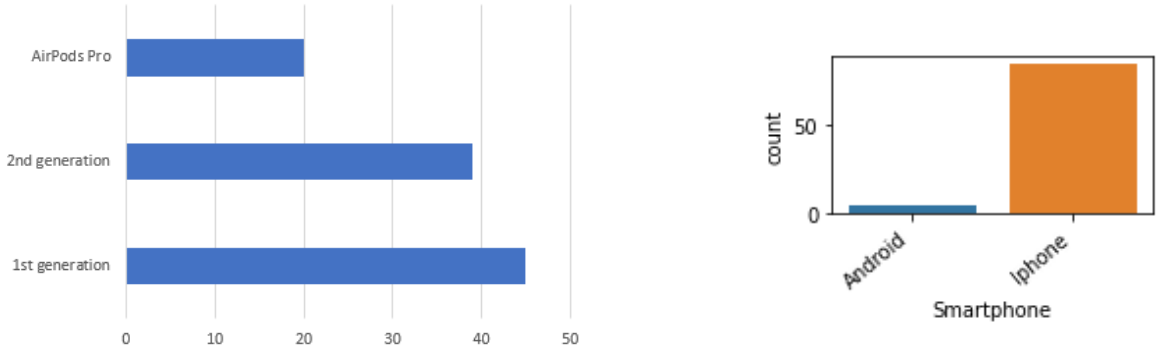


Figure 11: Generations and smartphone users' distribution

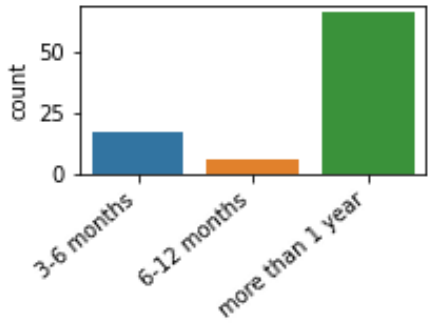


Figure 12: How long users have been using AirPods

- Second, how are users using AirPods? Data shows that people start wearing this device in the morning, starting a working day or going to school, and come back using it again in the late afternoon when they spend time exercising.

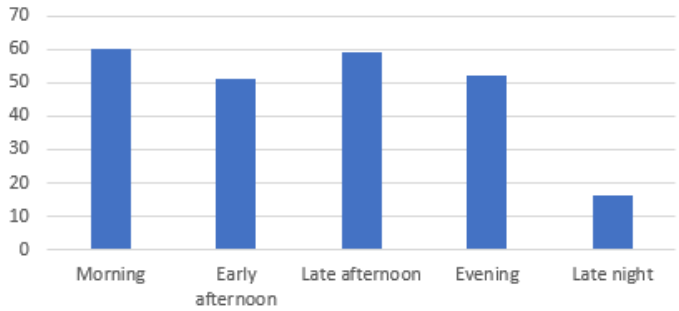


Figure 13: The time of the day people are using AirPods

Diving deeper at below specific activities aligned with the AirPods, we know that working/studying, exercising, and walking are among the top three respondents. This verifies our above assumption.

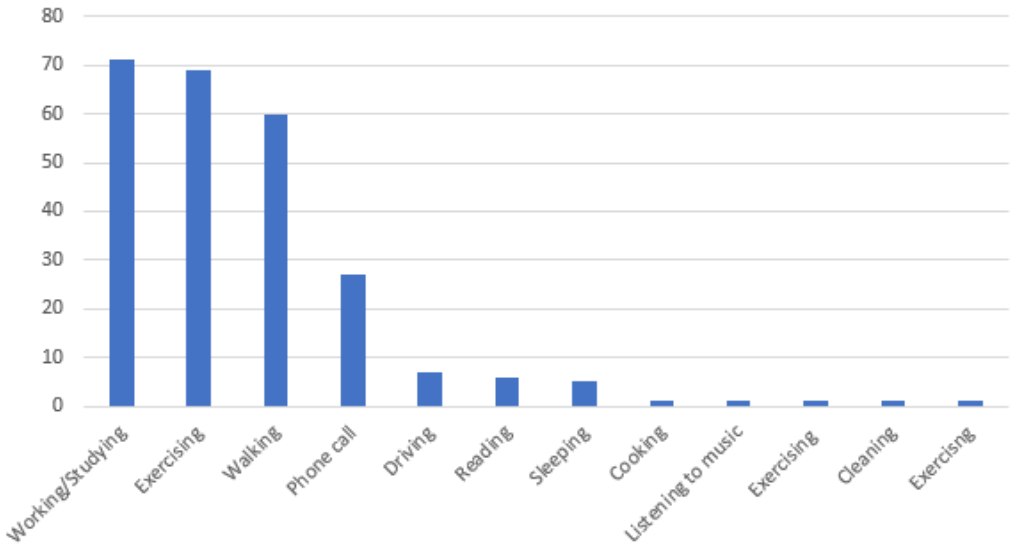


Figure 14: Popular activities people are doing when they use their AirPods

Last, as most people use AirPods 2-3 times per day, they usually spend 1-4 hours with this device.

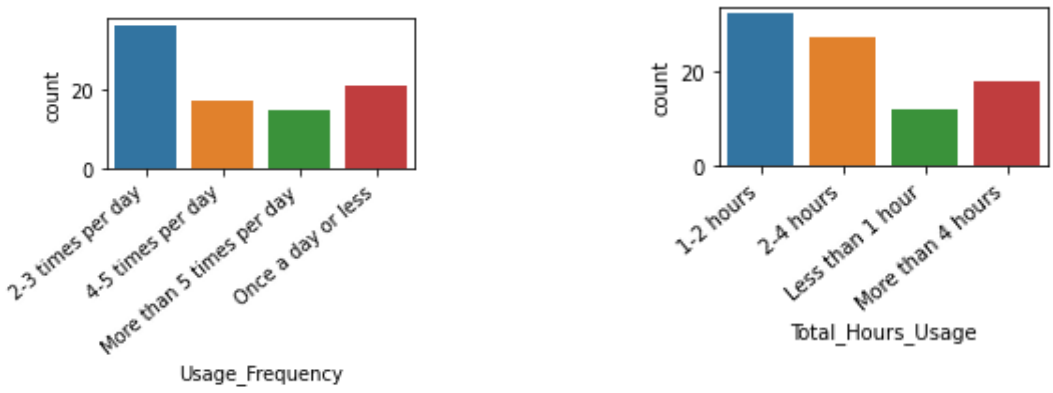


Figure 15: Usage frequency among AirPods users

c. Important features analysis

Data from the below tables show that the top 3 features, Battery life, Secure fit in ears, and Sound quality, receive the most attention from survey participants. Meanwhile, people see the two new features introduced by AirPods Pro: Noise cancellation and Water resistance, as less critical.

	Importance_Design	Importance_Secure_fit_in_ears	Importance_Sound_quality	Importance_Tapping_function
count	89.000000	89.000000	89.000000	89.000000
mean	2.022472	1.426966	1.539326	2.719101
std	1.011047	0.672303	0.840132	1.167639
min	1.000000	1.000000	1.000000	1.000000
25%	1.000000	1.000000	1.000000	2.000000
50%	2.000000	1.000000	1.000000	3.000000
75%	3.000000	2.000000	2.000000	4.000000
max	5.000000	3.000000	4.000000	5.000000

	Importance_Charging_speed	Importance_Bluetooth_pairing_process	Importance_Battery_life	Importance_Noise_cancellation(Pro)
count	89.000000	89.000000	89.000000	89.000000
mean	1.842697	1.573034	1.393258	2.606742
std	0.736991	0.851304	0.700941	0.747997
min	1.000000	1.000000	1.000000	1.000000
25%	1.000000	1.000000	1.000000	2.000000
50%	2.000000	1.000000	1.000000	3.000000
75%	2.000000	2.000000	2.000000	3.000000
max	4.000000	4.000000	4.000000	4.000000

Figure 16: Importance level among AirPods features

d. Satisfaction analysis

In general, Apple AirPods products received a very high level of satisfaction from consumers. 97.7% of surveyed customers said they were completely satisfied, very satisfied, or satisfied with the products. Regarding the overall satisfaction for each AirPods version, the outcomes have no much difference.

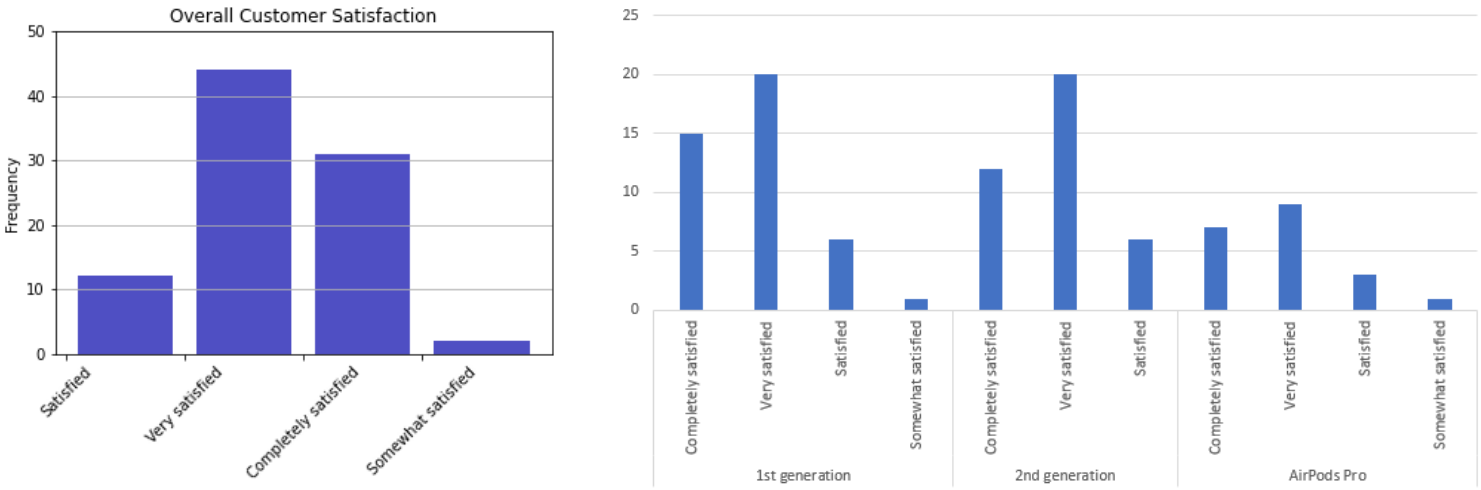
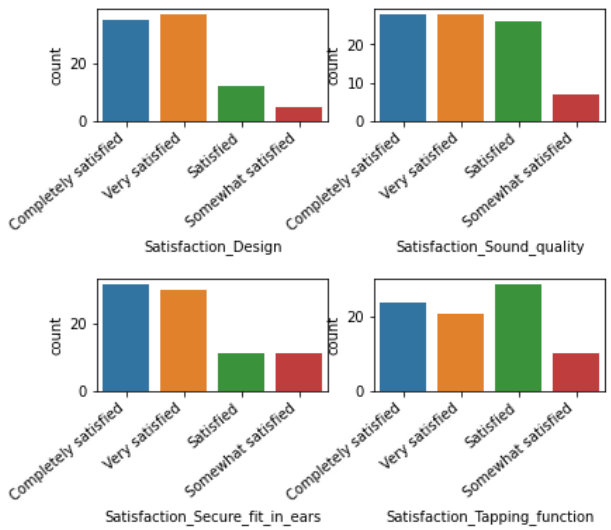
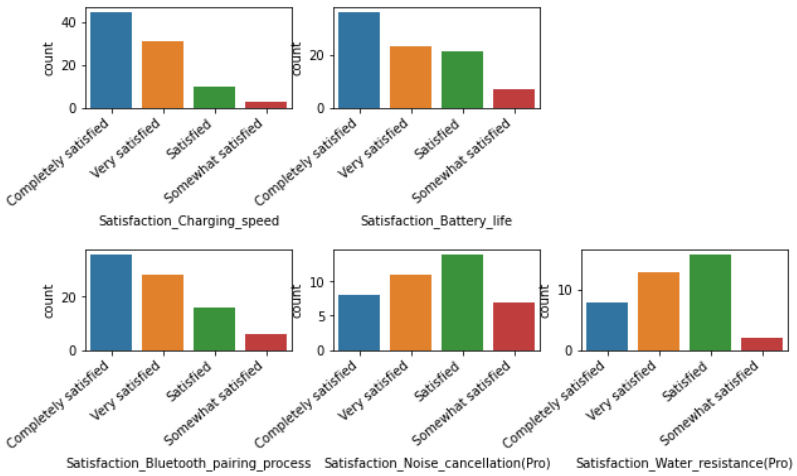


Figure 17: Overall satisfaction over AirPods

Diving deep into customers' satisfaction level for individual feature/function, we witness two patterns. First, people are highly satisfied with: Design, Charging speed, Bluetooth pairing, and Battery life. Second, people are not much satisfied with: Security Fit in Ears, Tapping function, Water resistance, and Noise cancellation. Data in the table show the mean satisfaction score for each feature input by customers (1-5 in the order of decreasing satisfaction).



	Satisfaction_Design	Satisfaction_Secure_fit_in_ears	Satisfaction_Sound_quality	Satisfaction_Tapping_function
count	89.000000	89.000000	89.000000	89.000000
mean	1.853933	2.179775	2.134831	2.449438
std	0.860108	1.211327	0.955736	1.167858
min	1.000000	1.000000	1.000000	1.000000
25%	1.000000	1.000000	1.000000	1.000000
50%	2.000000	2.000000	2.000000	2.000000
75%	2.000000	3.000000	3.000000	3.000000
max	4.000000	5.000000	4.000000	5.000000



	Satisfaction_Charging_speed	Satisfaction_Bluetooth_pairing_process	Satisfaction_Battery_life	Satisfaction_Noise_cancellation(Pro)
count	89.000000	89.000000	89.000000	89.000000
mean	1.674157	2.011236	2.056180	3.876404
std	0.808693	1.081816	1.080399	1.420789
min	1.000000	1.000000	1.000000	1.000000
25%	1.000000	1.000000	1.000000	3.000000
50%	1.000000	2.000000	2.000000	5.000000
75%	2.000000	3.000000	3.000000	5.000000
max	4.000000	5.000000	5.000000	5.000000

Figure 18: Satisfaction level of each feature

e. Correlation analysis

To see which variables are likely to affect the customer's overall satisfaction, I ran a correlation analysis of our independent variables against our dependent variable, overall satisfaction. This analysis ended up with a list of variables of interest that had the highest correlations with overall satisfaction.

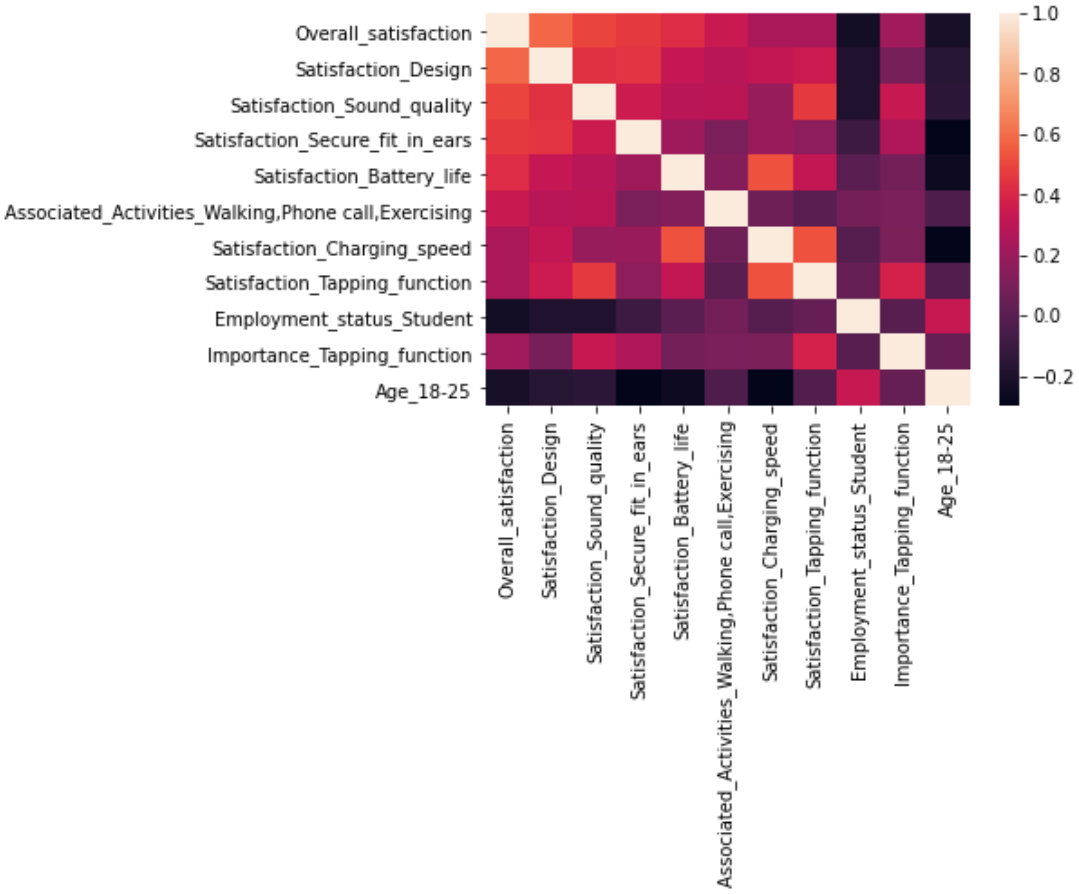


Figure 19: Correlation matrix

In order of highest correlation in absolute value with overall satisfaction, these variables are:

```
Overall_satisfaction                                  1.000000
Satisfaction_Design                                   0.584055
Satisfaction_Sound_quality                            0.496995
Satisfaction_Secure_fit_in_ears                       0.463851
Satisfaction_Battery_life                             0.422929
Associated_Activities_Walking,Phone call,Exercising   0.342801
Satisfaction_Charging_speed                           0.248262
Satisfaction_Tapping_function                         0.245714
Employment_status_Student                             0.236748
Importance_Tapping_function                           0.220123
Age_18-25                                             0.215029
Name: Overall_satisfaction, dtype: float64
```

Figure 20: Top 10 features that have the highest correlations with overall satisfaction, sorted by absolute values

For these independent variables, the next step to further analyze the associated relationship with our dependent variable was to create scatter plots. I picked four features for this visualization: Design, Sound quality, Secure fit in ears, and Battery life. A typical pattern can be observed. The

higher satisfied customers are about each of these four, the higher overall satisfied they are about the AirPods overall.

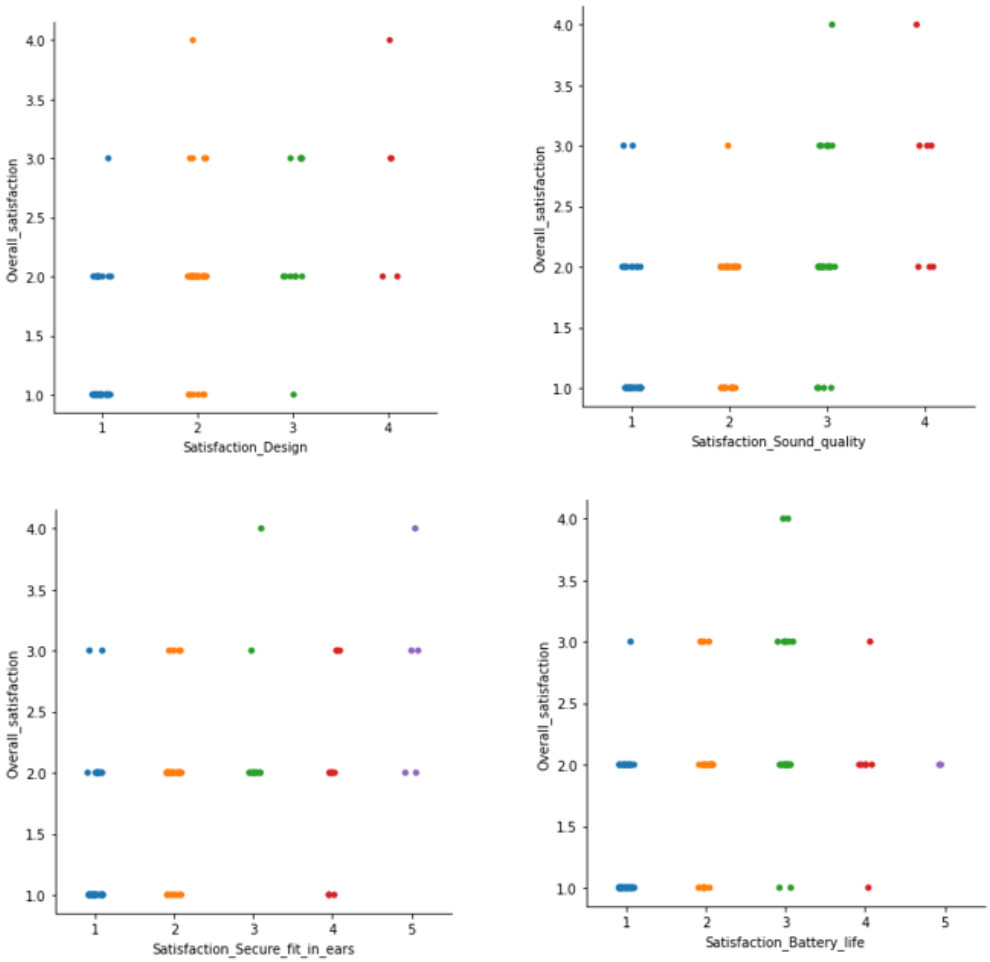


Figure 21: Scatter plots of overall satisfaction with four variables: Satisfaction design, Satisfaction sound quality, satisfaction secure fit in ears, and satisfaction battery life

To dive deep into relationships within independent variables and overall satisfaction, I built different three-dimensional plots. I took into account such demographic attributes as Age, Gender, and Employment status. I also considered the smartphone operating system people are using and how long they usually use their AirPods. When inspecting the two variables, Gender and Satisfaction – Sound quality with overall satisfaction, we can see that male users are less satisfied with sound quality but still highly satisfied with the overall product. Meanwhile, female customers are more sensitive with sound quality in scoring the overall satisfaction. Another pattern resulting from an interaction analysis using Satisfaction - Design and Age in relationships with overall satisfaction suggests that older customers, 26-35, are less satisfied with Design and, therefore, the overall product.

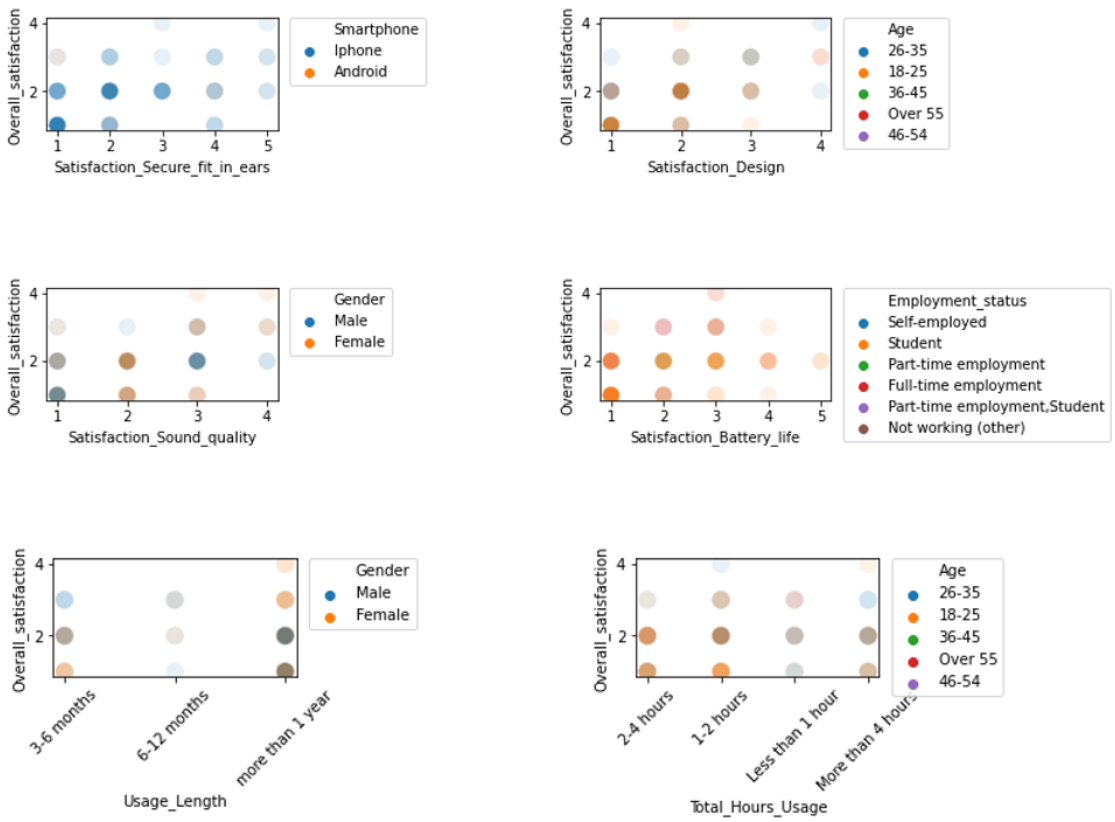


Figure 22: Three-dimensional scatter plots of overall satisfaction with independent features

f. Modeling and Importance of features

Based on the EDA and correlation analysis, I considered two potential models using machine learning techniques: Decision tree and Random forest. For the performance evaluation part, I then compared these two models by their accuracy.

Model 1: Decision tree

Decision tree is a popular model used in operations research, strategic planning, and machine learning. Decision trees are the building blocks of some of the most powerful supervised learning methods that are used today. A decision tree is a binary tree flowchart where each node splits a group of observations according to some feature variable. A decision tree's goal is to split your data into groups such that every element in one group belongs to the same category.

The "value" row in each node tells us how many-sorted observations into that node fall into each of our four categories: Complete satisfied, Very satisfied, Satisfied, and Somewhat satisfied. We can see that Satisfaction_Design and Importance_Sound_quality are two of the most important features that help distinguishes categories. The picture below shows the first four nods. A full decision tree can be found here.

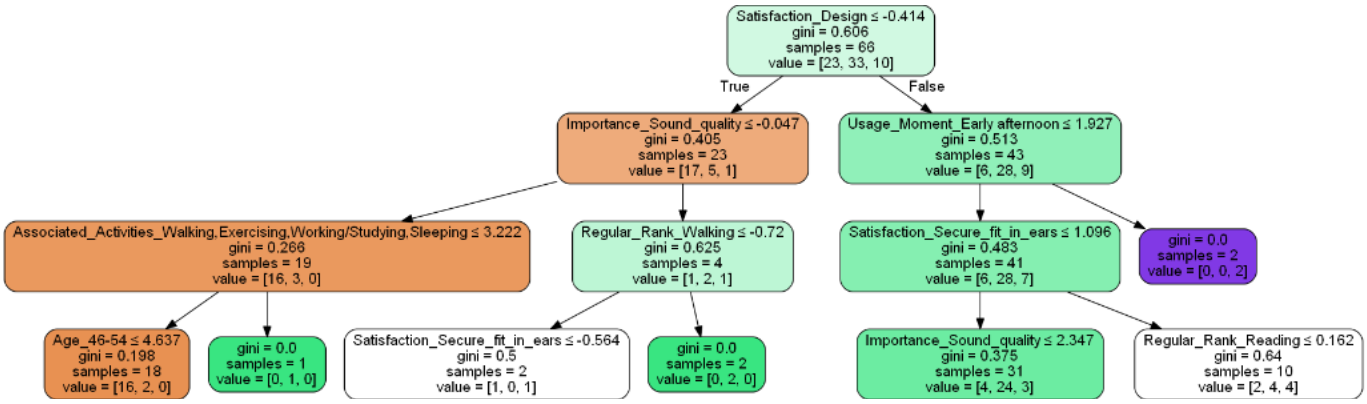


Figure 23: Decision tree plot

We have performance metrics as below:

```
[[6 1 1 0]
 [3 5 3 0]
 [1 1 0 0]
 [0 2 0 0]]
              precision    recall  f1-score   support

           1       0.60      0.75      0.67         8
           2       0.56      0.45      0.50        11
           3       0.00      0.00      0.00         2
           4       0.00      0.00      0.00         2

    accuracy                           0.48        23
   macro avg       0.29      0.30      0.29        23
weighted avg       0.47      0.48      0.47        23
```

Figure 24: Decision tree performance

Model 2: Random forest

Random forests are an ensemble learning technique that builds off of decision trees. Random forests involve creating multiple decision trees using bootstrapped datasets of the original data and randomly selecting a subset of variables at each decision tree step. The model then chooses the mode of all of the predictions of each decision tree. Relying on a "majority wins" model reduces the risk of error from an individual tree.

Using Random forest in this case, we have performance metrics as below:

```
              precision    recall  f1-score   support

           1       0.75      0.75      0.75         8
           2       0.60      0.82      0.69        11
           3       0.00      0.00      0.00         2
           4       0.00      0.00      0.00         2

    accuracy                           0.65        23
   macro avg       0.34      0.39      0.36        23
weighted avg       0.55      0.65      0.59        23
```

Figure 25: Random forest performance

By comparing the two models, the random forest seems to yield the highest accuracy level.

Importance of features: Below, I graphed the feature importance based on the Random Forest model. The top 4 features are Satisfaction – Design, Satisfaction – Secure fit in-ears, Satisfaction – Battery life, and Satisfaction – Sound quality.

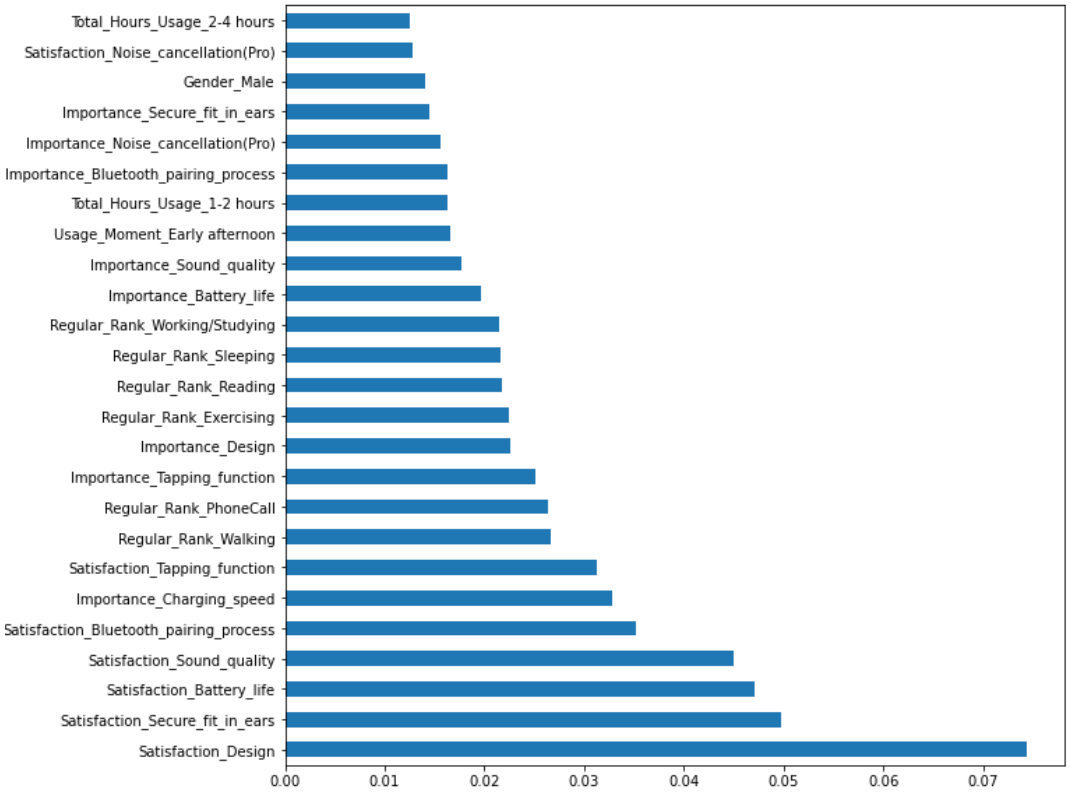


Figure 26: Top features of importance

g. Additional analysis - Voice of customers

If you could change one thing about the product, what would it be? From the survey, customers want to improve Battery life, Sound quality, Bluetooth paring process, and Tapping function.

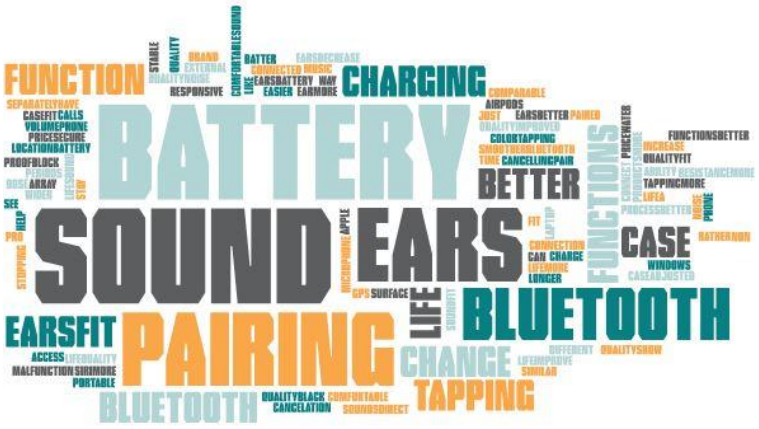


Figure 27: Popular ideas from AirPods users in terms of changing the product

E. Deployment

The respondents' overall satisfaction level towards the AirPods is relatively high (97.7% of customers were completely satisfied, very satisfied, or satisfied with the products). This is the same as the previously published survey, reinforcing that AirPods can bring a high satisfaction level to the users, explaining the device's dominant market share.

From the modeling analysis using machine learning techniques, we can see that the satisfactory level of **Design** will impact the overall satisfaction most. Apple can improve the overall satisfaction of the device by improving customers' satisfaction with this design feature.

The most important feature of the device is **Battery life** (mean = 1.39). However, this feature's satisfaction level is moderate (mean = 2.05), indicating an area for improvement. Satisfaction over battery life also impacts the overall satisfaction of the device. We recommend Apple to improve this feature for a higher satisfaction level. Some recommendations on improving battery *include increasing battery life, showing battery life on AirPods case rather than having to paired to phone to see battery life, or having a portable charging case.*

The other features: **Secure fit in ears** and **Sound quality** also tends to impact the customers' overall satisfaction on AirPods, especially when they use the device most for Working/Studying and Doing exercise. In 2019, Apple listened to the customer's voice by launching the new Apple AirPods Pro version with two new features: noise cancellation and improved fit in-ears. However, the survey suggests that people are still concerned about them. For that reason, Apple should invest more in improving these important functions to enhance the customers' satisfaction level.

Although **Tapping function** is not considered a significant feature, it receives the respondents' lowest satisfaction level. Respondents also provide insights on how to improve Tapping function, such as changing the volume with it, or more programs installed, or tapping on one ear can also work on the other ear. The company can invest more to improve this Tapping function since that would affect the customers' satisfaction over this feature, improving the overall satisfaction level.

However, this analysis has some limitations. The sample size of our survey is limited (89 respondents). Hence the sample may not be a good representative of the population. Besides, a small number of respondents use the latest version – AirPods Pro (19%), which may impact the overall conclusion regarding the recommendations for the future product.

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