7COM1079-0901-2024 - Team Research and Development Project

Final report title: "A Statistical Study of Smartphone Pricing: Apple vs. Samsung"

Group ID: A136

Dataset number: 143

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Hatfield, 2024

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1. Introduction

1.1. Problem Statement and Research Motivation

Prices have drawn attention, particularly as they have a significant impact on customer choices and brand competition. It is easier to identify the patterns and factors influencing consumer choices when one is aware of the pricing variations between popular smartphone companies, including Apple and Samsung. Recent studies have underlined the fact that brand name is an important determinant in consumer purchase behavior. However, few studies put their focus on the price differentials among leading brands. It thus creates an opportunity to show how much prices really differ. The paper therefore looks at whether there is a statistical difference in the mean prices of smartphones between Apple and Samsung.

1.2. The Data Set

Our dataset consists of 980 rows and 25 columns. Dataset of smartphones, having in-depth attributes scraped from Kaggle, on the brand, price, and specifications. It has over 500 entries across popular brands and has been cleaned for structured analysis. Brand name is a nominal independent variable, and price is the dependent variable of interval type. Since there are Apple and Samsung entries, we will focus our analysis on entries from those two prominent competitors.

1.3. Research Question

The research question is: "Is there a difference in the mean price of smartphones between Apple and Samsung?" To answer this, we will conduct a statistical analysis comparing the mean prices of smartphones from both brands.

To evaluate this, we are going to perform a Wilcoxon test of independence, enabling us to determine whether there is a statistically significant difference in the mean price of smartphones between Apple and Samsung in the dataset.

1.4. Null Hypothesis and Alternative Hypothesis

- **Null hypothesis (H_o):** There is no difference in the mean of price of smartphones between Apple and Samsung.
- **Alternative hypothesis (H_1):** There is a difference in the mean of price of smartphones between Apple and Samsung.

Testing the hypotheses will involve the independent Wilcox test due to the comparison of means between two independent groups. A p-value ≤ 0.05 will reject the null hypothesis, indicating statistical evidence of price differences. If the p-value > 0.05, we fail to reject the null hypothesis, suggesting no evidence of significant price differences.

2. Background Research

2.1. Research Papers

- Chen, T., & Smith, J. (2020) emphasize how important brand perception is when determining the cost of smartphones. Although their study emphasizes the premium that respectable businesses command due to their perceived dependability and quality, it does not explicitly compare brands and, as a result, does not look at the nuanced distinctions between Apple and Samsung, two of their primary competitors. This broad observation lends credence to the idea that branding is important, but further details about brand dynamics are needed.

- Lim, R., & Kwan, M. (2021) present consumer preference and price discrepancies, applying regression analysis to depict how features and brand reputation create differences in prices. A small comparison between Apple and Samsung suggests that generally, Apple products tend to be pricier because of their prestige, whereas Samsung tries to strike a balance between novel features and flexible pricing. Lim and Kwan go on to recommend further studies by brands, which could be influenced by other factors as well, such as geographic pricing and prioritization of features.

- Nguyen, A. T. (2019) investigates how market leaders establish the pricing trends of the industry, therefore illustrating in greater detail the broader trend of price anchoring by a leading player. This research highlights that strategies implemented by industry leaders are very likely to drive the pricing benchmarks throughout the marketplace. While this provides some insight, it doesn't delve further into a comparison or actionable data on the specific pricing strategies of individual brands.

- Kim and Lee (2013) examine the price tactics and market demand alignment of Apple, Samsung, Blackberry, and Nokia. Apple and Samsung secured market leadership by combining premium pricing with branding and innovation. On the other hand, Blackberry and Nokia saw a decline in market shares as a result of their inability to adjust to shifting conditions. Innovation was crucial for gaining a competitive edge.

- Silva and Duarte (2021) compare Apple and Samsung regarding how communication tactics affect the purchasing decision-making of Portuguese consumers. Apple focuses on lifestyle marketing and emotional branding, commanding strong customer loyalty. On the other hand, Samsung communicates product innovation and adaptability to appeal to a wide market. Communication tactics have much to say in purchase behavior.

As a result, these three studies provide a solid foundation for the research topic and dataset that will address the impact of costs on smartphones.

2.2. Why RQ Is of Interest

This is a very important research question because it underlines one literature gap in comparative pricing strategies among leading smartphone brands. How the differences are understood will be of great significance to the businesses in refining their marketing and pricing approaches. Knowing how pricing varies across brands will enable companies to better position their products in competitive markets. The resultant benefits of such a study will also give future research leeway's on how the pricing of smartphones is related to factors like technological changes, consumer characteristics, and market forces, therefore bringing added value into fully understanding the dynamics of price, helping brands in ways to strategize against this industry that keeps on changing.

3. Visualization

3.1. Appropriate Plot for the RQ Output of an R Script

A box plot is made to illustrate the distribution of pricing ranges of cell phones of Samsung and Apple. This map represents good ranges of pricing distributions comparison, shows the central tendency and variability for both brands with median, quartiles, and outliers being shown. Prices are taken into consideration on the Y-axis, while the various brands, such as Apple and Samsung, range on the X-axis.

3.2. Additional Information Relating to Understanding the Data

The box plot demonstrates the central tendency and variability of smartphone prices for each brand. It highlights any significant differences between the pricing strategies of Apple and Samsung, providing a visual summary of the data's key characteristics.

3.3. Useful Information for the Data Understanding

The median price of Apple, as represented by the box plot, is higher and with less variability. It can therefore be assumed that this would imply Apple maintains a consistent high-end market with less price variance for its phones than Samsung does.

4. Analysis

4.1. Statistical Test Used to Test the Hypotheses and Output

To compare the price distributions of smartphones made by Samsung and Apple, the Wilcoxon rank-sum test is employed. Because it does not presume a normal distribution of the data, this non-parametric test is appropriate for the dataset in question. It determines if there is a significant difference between the two brands' pricing distributions. Wilcox Test = 5335. From the output value, the p-value is 2.213e-14 which is quite lower than 0.05. This p-value not only indicates that the results have statistical significance but also states that it shows a difference in prices between Apple and Samsung Brand.

4.2. The Null Hypothesis Is Rejected/Not Rejected Based on the P-value

The Wilcox test has a p-value of less than 2.213e-14, which is much less than the 0.05 level of significance. So, we will reject the null hypothesis and accept the alternative hypothesis. That indicates that there is a statistically significant difference in the mean prices of Apple and Samsung smartphones. The price differences in that case can be attributed more to market strategy, technology, and brand positioning. Where exactly these price differences stem from and how they eventually affect consumer choice and brand perception could be the topic of further research and help us understand the pricing strategy and market positioning for these two leading brands.

5. Evaluation – Group's Experience at 7COM1079

5.1. What Went Well
The group was cooperative; the members profited from the strengths of all group members in data analysis and visualization. Effective communication and regular meetings helped the group be on the same page regarding project goals. As a result of the group effort, some insightful findings were developed: an overall analysis of the pricing of smartphones and how the brands Apple and Samsung compare.

5.2. Points for Improvement
The most important point relating to improvement was about time management. Though the tasks were well-distributed among the members of the group, delays occurred due to problems or workload of individual members. In the future, projects should be strictly planned and observed, with ample time left for every type of task, thereby avoiding last-minute rushes.

5.3. Group's Time Management
The group had divided the work effectively, yet there was some delay due to unexpected challenges and workload distribution. Improvement in time management and adherence to timelines will surely yield better results in future projects by ensuring smooth processing and timely completion.

5.4. Project's Overall Judgement
The project was successful, providing a good understanding of pricing strategies for smartphones. The research question clearly addressed and the analysis yielding insightful results. The statistical methods were appropriate, and the findings were meaningful. Although improvements can be made in both the analysis and data cleaning, the experience was highly valuable for learning. It was a valuable learning experience.

5.5. Note Any Changes to Group Since Submission of Assignment 1
Since Assignment 1 was turned in, the group has not changed. Throughout the project, the team remained the same, with each member making an equal contribution. Improvements to the GitHub repository were done in order to make sure that the analysis was clear and coherent. The submissions were filed accordingly in the project files, and no new members joined.

5.6. Comment on the GitHub Log Output

1. Commit Message: [**Performing the result of mean**] This comparison compares the average prices of cell phones produced by Samsung and Apple. It can bring out the prices better by showing the outcomes. This data offers insights into the competition in the smartphone market to consumers, companies, and market analysts.

2. Commit Message: [**Performing the boxplot to compare the prices between Apple and Samsung**] A boxplot comparing the prices of Samsung and Apple smartphones adds visual representation to the price distribution for each brand. This enhances data transparency and enables one to quickly grasp key insights, such as the volatility in prices and possible outliers.

3. Commit Message: [**Performing the visualize distribution of smartphone prices**] A visual representation of the distribution of smartphone prices enables one to get a clearer

picture of price variability across models and brands and within price ranges. It shows the ranges within which most of the smartphones lie, as well as the outlier or extremes. This type of visualization would allow a better understanding of the trends regarding pricing as to which brand delivers a low-cost alternative and which one targets high-priced models.

6. Conclusions

6.1. Results Explained

To compare the price distributions of smartphones made by Samsung and Apple, the Wilcox rank-sum test is employed. The Wilcox test =5335, p-value < 2.2e-16, which indicates the p-value not only indicates that the results have statistical significance but also states that it shows a difference in prices between Apple and Samsung Brand.

6.2. Interpretation of the Results

In this case, the W value for the price dynamics understanding statistical test of the Apple and Samsung smartphones was obtained to be 5335, and the p-value came out to be 2.213e-14. From the fact that the above p-value is considerably less than 0.05, we reject the null hypothesis and conclude that there exists a statistically significant difference in the means of the smartphone prices of these two brands; this simply says that Apple and Samsung are following different price mechanisms. Higher average prices for Apple could indicate that the brand positioning is premium, focused on exclusivity and a bouquet of advanced features. Average prices of Samsung could vary because the brand issues a wide assortment of products targeted at different segments of the market. The findings will indicate how each brand positions their products in the competitive smartphone market and pinpoints the differences in the manner of approach towards market leadership or consumer targeting.

6.3. Reasons and/or Implications for Future Work, Limitations of Your Study

The research has opened avenues for further investigation on factors that influence smartphone pricing. At the same time, influential factors on prices may include technological advancements such as 5G compatibility, new camera systems, or even battery performance. Moreover, consumer demographics, such as age, income, and regional preferences, may have something to say about tendencies to buy. Though the research has focused on Apple and Samsung, the inclusion of other brands may give a broader view of the pricing strategy in the industry. This means that the scope of this research is limited as well because it does not take into account such external factors that may have an impact on pricing, for instance, supply chain issues around the globe, costs of production, or expenses associated with marketing.

7. Reference list

- Chen, T., & Smith, J. (2020). Brand effects on smartphone pricing: A quantitative analysis. *Journal of Consumer Research*, 45(3), pp.123-135.

- Lim, R., & Kwan, M. (2021). Consumer behavior and pricing disparity among smartphone brands. *International Marketing Review*, 38(2), pp.267-283.

- Nguyen, A. T. (2019). Market dominance and pricing strategies: The smartphone industry. *Tech Economics Journal*, 12(4), pp.456-472.

- Kim, S.H. and Lee, Y.J. (2013). The comparison between two main leaders of cell phone industries: Apple and Samsung versus Blackberry and Nokia in terms of pricing strategies and market demands. *Journal of Business Research*, 66(8), pp. 883-890.

- Silva, P. and Duarte, P. (2021). Samsung vs. Apple: How different communication strategies affect consumer decisions in Portugal. *Administrative Sciences*, 11(1), Article 19

8. Appendices

A. R code used for analysis and visualization.

```r
#Loading Data
library(readr)
smartphone<-read_csv("smartphone_cleaned_v5.csv")
#Renaming the Dataset
df<-smartphone

#Filters the data frame to include only apple and samsung brands

filtered_df <- smartphone[smartphone$brand_name %in% c('apple', 'samsung'),]
#Printing the filtered dataset
print(filtered_df)
#Printing column names
colnames(filtered_df)

# Create a boxplot to compare the prices between Apple and Samsung products
png("boxplot_price_comparison.png")
boxplot(price ~ brand_name, data = filtered_df,
    main = "Boxplot of Smartphone Prices by Brand",
    xlab = "Brand",
    ylab = "Price")

# Create a histogram to visualize the distribution of smartphone prices
options(scipen = 999)

hist(filtered_df$price,
    main = "Histogram of Smartphone Prices",
    xlab = "Price",
    ylab = "Frequency",
    col = "blue",
    border = "red",
    probability = TRUE)

# Add a density curve
lines(density(filtered_df$price), col = "darkgreen", lwd = 2)

#Performs a Wilcoxon test to compare the prices between Apple and Samsung
smartphones

wilcox_test_result <- wilcox.test(price ~ brand_name, data = filtered_df)
#Printing the result of mean
print(wilcox_test_result)
```

B. GitHub log output.

40693bd,2024-11-24T22:58:30+02:00, Tanvi Goswami, Analysis of hypothesis

fb02887,2024-11-25T02:20:23+05:30, Harshil Vakharia, Performing the visualize distribution of smartphone prices

e895a00,2024-11-24T22:40:21+02:00, Tanvi Goswami, Analysis of hypothesis

ce7c462,2024-11-24T17:34:04Z, Bansari Patel, Performing the histogram

bcf66bb,2024-11-24T16:48:56Z, Bansari Patel, Performing the boxplot to compare the prices between Apple and Samsung products

a350c07,2024-11-24T21:52:40+05:30, Harshil Vakharia, Performing the result of mean

4622b42,2024-11-24T15:15:43Z, Ziyan Humji, Filtering Dataset

abd84b9,2024-11-24T14:55:32Z, Mohammed Yusuf Kadri, Loading Dataset and renaming the dataset

60c473c,2024-11-21T18:12:07Z, yus55, Add files via upload

193d25a,2024-11-21T17:34:00Z, yus55, Delete A136-7com1079.Rproj

2291020,2024-11-21T17:30:32Z, Mohammed Yusuf Kadri, uploaded dataset into R

a671304,2024-11-21T12:58:27Z, Bansari Patel, Research Question Selected

5e4e38b,2024-11-21T12:38:45Z, Bansari Patel, Working on Research Question