Preliminary Study for Analysis of Apple Stock Price: Influence of iPhone Product Launches on Stock Performance

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- **Introduction/Motivation**

The proposed study aims to explore the impact of Apple Inc.'s product launches on its stock price. Apple, as a leading technology company, has a significant influence on the stock market, particularly through its highly anticipated product launches. This study seeks to understand whether these events serve as market movers, influencing investor behaviour and thereby affecting Apple's stock price. The motivation behind this research is to identify potential patterns or anomalies in stock price movements following product launches, which could be crucial for investors and market analysts.

Existing Literature/Basics

Previous research has often focused on the broader impact of corporate events on stock prices. Studies specific to technology companies, especially giants like Apple, have indicated mixed results. Some suggest a positive correlation between product announcements and stock performance, while others highlight a negligible or even negative impact. This discrepancy in findings underscores the need for more focused research, particularly considering the evolving nature of consumer technology and market dynamics.

- **Methodology/Hypotheses**

The study will adopt a quantitative research approach, utilizing time series analysis to examine the relationship between Apple's product launch events and its stock price. The hypothesis is that Apple's stock price experiences significant fluctuations around the dates of major product launches (H1). The Null hypothesis is that Apple's stock price does not experience significant fluctuations around the dates of major product launches.

- **Data and Sources:**

- **Stock Price Data:** Historical daily closing prices of Apple Inc. (AAPL) stock, sourced from finance websites like Yahoo Finance or financial databases like Bloomberg.
- **Product Launch Data:** Dates of some of the major Apple product launches (e.g., iPhone, iPad, MacBooks, and major software releases) over the past decade, which can be obtained from Apple's press releases or technology news archives.

Example of iPhone Launch dates:

Historical timeline of Apple iPhone launches, including release dates for various models.

The release dates for each iPhone model from 2007 to 2023 :

- iPhone: June 29, 2007

- iPhone 3G: July 11, 2008
- iPhone 3GS: June 19, 2009
- iPhone 4: June 24, 2010
- iPhone 4S: October 14, 2011
- iPhone 5: September 21, 2012
- iPhone 5S & 5C: September 20, 2013
- iPhone 6 & 6 Plus: September 19, 2014
- iPhone 6S & 6S Plus: September 19, 2015
- iPhone SE: March 31, 2016
- iPhone 7 & 7 Plus: September 16, 2016
- iPhone 8 & 8 Plus: September 22, 2017
- iPhone X: November 3, 2017
- iPhone XS, XS Max: September 21, 2018
- iPhone XR: October 26, 2018
- iPhone 11, Pro, Pro Max: September 20, 2019
- iPhone 12, Mini, Pro, Pro Max: November 13, 2020
- iPhone 13, Mini, Pro, Pro Max: September 24, 2021
- iPhone SE 3 (2022): March 18, 2022
- iPhone 14, Pro, Pro Max: September 16, 2022
- iPhone 14 Plus: October 6, 2022
- iPhone 15, Plus, Pro, Pro Max: September 22, 2023

(Source: https://www.bankmycell.com/blog/iphone-evolution-timeline-chart)

- **Methodologies:**

Approach with SARIMA and ARCH Models

To conduct the analysis of Apple's stock price in relation to its product launches, we will specifically focus on the SARIMA (Seasonal Autoregressive Integrated Moving Average) and ARCH (Autoregressive Conditional Heteroskedasticity) models. These models are well-suited for handling the seasonal patterns and volatility dynamics, which are characteristic of financial time series like stock prices.

1. SARIMA Model for Seasonality and Trend Analysis

- **Purpose:** SARIMA is ideal for modelling time series data with both non-stationarity and seasonality, two features likely present in Apple's stock price data, especially considering the cyclical nature of product launches.

- **Implementation:**

- o **Data Pre-processing:** Assess stationarity using tests like the Augmented Dickey-Fuller (ADF) test. Differencing might be employed to achieve stationarity.
- o **Model Configuration:** The SARIMA model will be parameterized with seasonal and non-seasonal components (p, d, q) x (P, D, Q, S), where p, d, q are the non-seasonal parameters and P, D, Q, S are the seasonal components.
- o **Model Fitting:** Fit the SARIMA model to the historical stock price data of Apple, using R packages like **forecast** or **stats**.
- o **Event Analysis:** Analyse the residuals from the SARIMA model around the product launch dates to assess any abnormal deviations.

2. ARCH Model for Volatility Analysis

- **Purpose:** The ARCH model is particularly adept at modelling the changing volatility in stock price time series. Given that product launches may lead to increased trading and price volatility, this model can provide valuable insights.

- **Implementation:**
  - o **Volatility Assessment:** After fitting the SARIMA model, the next step is to examine the residuals for volatility clustering, a key indication for employing the ARCH model.
  - o **Model Configuration and Fitting:** Use the **tseries** package in R to fit an ARCH model to the residuals of the SARIMA model. This involves determining the lag length 'q' for the ARCH model.
  - o **Volatility Analysis:** Examine the conditional variances from the ARCH model to understand how volatility patterns change around the product launch dates.

Integrating SARIMA and ARCH Models in Event Study

- **Combined Analysis:** The residuals and volatility patterns identified from the SARIMA and ARCH models will be analyzed in the context of the event study framework. Specifically, the period around the product launch dates will be scrutinized to identify any significant changes in stock price trend or volatility that deviate from the model's predictions.

- **Statistical Testing and Validation:** Perform statistical tests (like the Ljung-Box test for residuals) to validate the model's adequacy. Additionally, test the significance of changes in residuals and volatility during the event windows to determine the impact of product launches.

This focused approach using SARIMA and ARCH models provides a robust framework for analysing how Apple's product launch events influence its stock price movements, considering both trend/seasonality and volatility aspects, aligning with a high level of academic rigor expected for this time series analysis project.

- **Possible Results/Discussion**

The expected outcome is a clear depiction of how Apple's stock price responds to its product launches. If the hypothesis holds true, we should observe abnormal returns around the launch dates. The results will be discussed in the context of market efficiency and investor sentiment, providing insights into how major product announcements are perceived and acted upon in the financial markets.

- **<u>Expected Conclusion</u>**

This study will contribute to the understanding of the interplay between corporate events and stock market performance, specifically in the context of a tech giant like Apple. The findings are expected to have practical implications for investors, traders, and financial analysts, offering a nuanced perspective on how product launches can serve as catalysts for stock price movements.