Project 1 Claudio Palmeri N. 2062671
Name of the company: **Visa Inc.**

Visa Inc. operates as a payments technology company worldwide which serves consumers, merchants, financial institutions, and government entities. Visa Inc. was founded in 1958 and is headquartered in San Francisco, California. Its website is: https://usa.visa.com and its telephone number is 650 432 3200

The company operates VisaNet, a transaction processing network that enables authorization, clearing and settlement of payment transactions.
It also offers credit, debit, and prepaid card products; tap to pay, tokenization, click to pay; Visa Direct, a real-time payments network; Visa B2B Connect, a multilateral B2B cross-border payments network; Visa Treasury as a Service, a cross-border consumer payments business; and Visa DPS that provides a range of value added services, including fraud mitigation, dispute management, data analytics, campaign management, a suite of digital solutions, and contact center services.
Further, the; company provides Cybersource, a payment management platform; and risk and identity solutions, such as Visa Advanced Authorization, Visa Secure, Visa Advanced Identity Score, and Visa Consumer Authentication Service; and Visa Consulting and Analytics, a payments consulting advisory services.

The most influential executives in the company are:

| Name | Title | Pay ($) |
|---|---|---|
| Mr. Alfred Francis Kelly Jr. | Exec. Chairman | 8M |
| Mr. Ryan M. McInerney | Pres, CEO & Director | 4.65M |
| Mr. Vasant M. Prabhu | Vice Chair & CFO | 4.65M |
| Mr. Rajat Taneja | Pres of Technology | 4.65M |
| Ms. Kelly Mahon Tullier | Vice Chair, Chief People & Corp. Affairs Officer and Corp. Sec. | 3.26M |
| Mr. Peter Andreski | Sr. VP, Global Corp. Controller & Chief Accounting Officer | N/A |
| Ms. Jennifer Como | Head of Investor Relations | N/A |
| Ms. Julie B. Rottenberg | Gen. Counsel | N/A |
| Mr. Frank Cooper III | Chief Marketing Officer | N/A |
| Mr. Oliver Jenkyn | Group Pres of Global Markets | N/A |

This is the overall evolution of the stock price from the beginning:

Visa Inc.’s ISS Governance QualityScore as of March 1, 2023 is 4.

98.70% of the shares are held by institutions, more precisely the top institutional holders are:

| Holder | Shares | % out | Value ($) |
|---|---|---|---|
| Vanguard Group, Inc. (The) | 147,356,830 | 9.07 | 32.424B |
| Blackrock Inc. | 124,903,850 | 7.69 | 27.484B |
| State Street Corporation | 70,324,953 | 4.33 | 15.474B |
| Morgan Stanley | 51,122,866 | 3.15 | 11.249B |
| Price (T.Rowe) Associates Inc | 51,100,136 | 3.14 | 11.244B |
| FMR, LLC | 48,538,399 | 2.99 | 10.68B |
| Geode Capital Management, LLC | 32,221,146 | 1.98 | 7.09B |
| Bank of America Corporation | 26,482,036 | 1.63 | 5.827B |
| AllianceBernstein, L.P. | 26,184,849 | 1.61 | 5.762B |
| Massachusetts Financial Services Co. | 23,231,725 | 1.43 | 5.112B |

Some useful statistics on the company Visa Inc. are:

| Feature | Value |
|---|---|
| Market Cap | 456.91B$ |
| Profit Margin | 50.28% |
| Revenue | 30.19B$ |
| Revenue per share | 14.55$/share |
| Quarterly Revenue Growth | 12.40% |
| Gross Profit | 28.57B$ |
| Total Cash | 16.12B$ |
| Total Cash per share | 7.84$/share |
| Total Debt | 20.49B$ |
| Forward Annual Dividend Yield | 0.83% |

**Analysis of two call options prices:**

All the data was taken in the day 23/03/2023
The current price of the stock is **s=220.04 USD**.

We will analyze two call option during this report:
Both will have strike price at the money, i.e. equal or very close to the current price of the stock.
What will vary between the two will be the maturity time, either T=3 months or T=6 months.

I'm going to indicate with **"_1"** the former and with **"_2"** the latter.

Strike prices:

**K_1=220.00 USD that expires on 16/06/2023**
**K_2=220.00 USD that expires on 15/09/2023**

Our target price, that we hope to predict with a binomial model, is given by the average between asking and bidding price of the option calls.

**t_1=(12.80+13)/2=12.90 USD**
**t_2=(18.55+19)/2=18.78 USD**

We proceed now to download the daily historical data of our stock prices in the previous 3/6 months while considering the adjusted close price as our official daily price.
This data is used to calculate the daily returns of our stock with the formula:

**return(t)=(s(t)-s(t-1))/(s(t-1))** where s(t) is the price of the stock at time t

After doing so we can calculate the daily volatility sigma_d by computing the standard deviation of our daily return. Since we are estimating it from a set of observation we will need to use the formula

**sigma_d=sqrt(sum((return(t)-mu)^2)/(m-1))**
where we are summing over all the return(t) that we calculated earlier, mu is the mean of our aformentioned returns (mu=(1/m)*sum(return(t)) ) and m the number of daily returns we calculated.

**sigma_d_1=0.010914**
**sigma_d_2=0.014968**

Then we can compute the yearly volatility by **multiplying** the **previous result** by the **sqrt(252)**
(This is because there are 252 working days in a year)

**sigma_y_1=0.173253**
**sigma_y_2=0.237612**

We can now start to build our binomial model with T=1/4 or 1/2 and n=1 time steps.
First of all we estimate the parameters u,d with the following formula:

**u=exp(sigma_y*sqrt(T))** **d=exp(-sigma_y*sqrt(T)**
where u,d represent the two possible price movements that we allow in our model between time 0 and time 1. (i.e. if s is the initial price, su and sd are the two possible final prices)
Thus we get the following results:

**u_1=1.090489** **d_1=0.917019**
**u_2=1.182957** **d_2=0.84534**

We need to be careful because our stock produces dividends.
According to Yahoo finance the dividend yeld is 0.83% annually and thus I'll add 0.0083/4 to both u and d in the 3 month contract and similarly I'll add 0.0083/2 in the 6 month contract.
(More precisely **su+s*yeld*T=s*(u+yeld*T)=s*ū** and similarly for **đ**)

**ū_1=1.092564** **đ_1=0.919094**
**ū_2=1.187107** **đ_2=0.84949**

Interest rates need to be considered while computing the starting price of an option and thus we need to visits www.global-rates.com in order to get the LIBOR rate corresponding to both time frames.

**Libor_1=5.01771%  (USD LIBOR 3 months)**
**Libor_2=5.00657%  (USD LIBOR 6 months)**

We can now calculate the capitalization and actualization factor. We are required to use the simple interest formula and thus we will get:
**cap=(1+Libor*T), act=1/(1+Libor*T)**

**cap_1=1.012544**  **act_1=0.987611**
**cap_2=1.025033**  **act_2=0.975578**

We can calculate now the risk neutral probability weight q of our model by using the formula:
**q=(cap-đ)/(ū-đ)** where q represents the probability that the market goes up to sū

**q_1=0.538709**
**q_2=0.519948**

We are finally able now to compute the price of an option call. In order to do this we need to actualize the expected value of our payoff. The payoff is **220ū-220** if the price goes up and **0** if it goes down.
(This is because the payoff of a call option is the **positive part of (final price-strike price))** ). Thus:

**price=act*(q*220*ū-1+(1-q)*0)**
We get:

**price_1=10.83446 USD**
**price_2=20.88016 USD**

**Conclusion:**

Our model didn't precisely predicts the price of both call option.
We made the following errors:

| **Contract** | **T=1/4** | **T=1/2** |
|---|---|---|
| Absolute Error | 2.06554 | 2.10016 |
| Relative Error | 0.16012 | 0.11183 |
| % Relative Error | 16.01% | 11.18% |

This imprecision can be explained by the simplicity of our model which can't fully emulate the ones used in the real world.