

Pricing Model of Asian Option on Moutai

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Abstract: Power load forecasting is very important for power dispatching. Accurate load forecasting is of great significance for saving energy, reducing generating cost and improving social and economic benefits. In order to accurately predict the power load, based on BP neural network theory, combined with the advantages of Clementine in dealing with big data and preventing overfitting, a neural network prediction model for large data is constructed.

1. Introduction

Stocks are securities that represent an ownership share in a company. For companies, issuing stock is a way to raise money to grow and invest in their business. For investors, stocks are a way to grow their money and outpace inflation over time [1]. Nowadays, to seek potential fortune, more and more people entering the stock market. Every investor wants the shares that they have already purchased to increase dramatically in a short time. Many historical stock events indicated this market is miraculous. Frankly, the stock is part of the financial system, which can be analyzed in financial tools such as formula or theory. In this world, there are many types of stock markets that work differently. Based on the characteristics of a certain type of stock market, both the companies and investors will choose the most beneficial one. For example, the Asian option, European option, and American option. Randall Smith, in the Wall Street Journal, said: Investors using options to make riskier bets, speculating on near-term movements in individual stocks and funds [2]. This means the investors are looking for the best option to lower their risk and make money. Therefore, how to choose a suitable option in the stock market, is important for people who want to make fortune.

In another research paper, the author Weiping Li and Su Chen introduce An Asian option is a type of option whose payoff includes a time average of the underlying asset price [3]. For the investors, the average asset price lowers their risk. For instance, because of the unexpected circumstance that happened in a certain period, which cause the stock market into an extreme condition, the Asian option is less sensitive to this condition. Furthermore, the call and put option can also involve in the stock market, which presents the basic rule of the stock market exchange. This type of option is the options can be defined as contracts that give a buyer the right to buy or sell the underlying asset, or the security on which a derivative contract is based, by a set expiration date at a specific price [4-6]. This type of underlying asset is called the strike price. The strike price is pre-determined on a particular day without any obligation so that it is similar to the Asian option.

In this paper, we are focusing directly on the Asian option. By analyzing more on the Asian option, we utilize a specific example that belongs to this option: Kweichow Moutai Co. A unique A-shares stock that contains a large amount of historical data that we could research. This type of stock will reflect the characteristics of the Asian option. Moreover, we propose a comparison between the Asian option and the European option, by stating the difference between these two options and calculating

the risk-free rate as well as the sensitivity analysis, which will clearly present the advantages in the Asian option.

The most important thing is, we would append the call and put the option to discuss more on these models. The options can be defined as many ways as possible, the Asian and Call and put is from the different area but connect tightly, we can discuss it with the strike price and option price.

This paper is organized as follows: section 2 is the firm description. Section 3 is introducing the model of the option pricing, including the definition, formula, and model of the Asian option as well as the European option, also the difference between them. Section 4 operates the result analysis. Section 5 is conducting the Sensitive analysis. Section 7 is the final discussion to the investors. And the last section is for the conclusion.

2. Firm description

China Kweichow Moutai Distillery company is a state-owned enterprise which is listed on the Shanghai Stock Exchange in 2001. Throughout its unique industries (Consumer and Aperiodic) in the Chinese stock market, which has become the world's largest beverage company and the most valuable non-technology company in China [7]. In 2021, the stock price is exceeding 1600 RMB per share.

This company is most specializing in the production and sales of the spirit Maotai baijiu, which is popular among Chinese culture. Like Lafite Rothschild wine from France, Chinese people love to enjoy this kind of spirit at the dinner table. Kweichow Moutai company also produces and sells other beverage, food, and packaging material. Furthermore, it develops anti-counterfeiting technology and research and development of relevant information technology products.

For its financial, which market cap is 2.06 trillion. In the previous 12 months, the total revenue of this company is 100.05B, and the revenue per share is 79.65. Compared with the same period last year, Kweichow Moutai company's quarterly revenue grow to 11.6%. And its quarterly earnings growth up to 12.5%. By checking the cash flow statement, in the past 12 months, the operating cash flow is 60.77 billion and the levered free cash flow is 141.39 billion. The balance sheet is known as the statement of financial position, which will clearly reflect the company's assets, liabilities, and ownership equity in a certain period. With the formula $\text{assets} = \text{liabilities} + \text{ownership equity}$, the viewers could analyze easily in this sheet. The total cash in the most recent quarter is 148.97 billion, but its total debt is 519.38 million. The total debt only takes up 0.31 to the ownership equity.

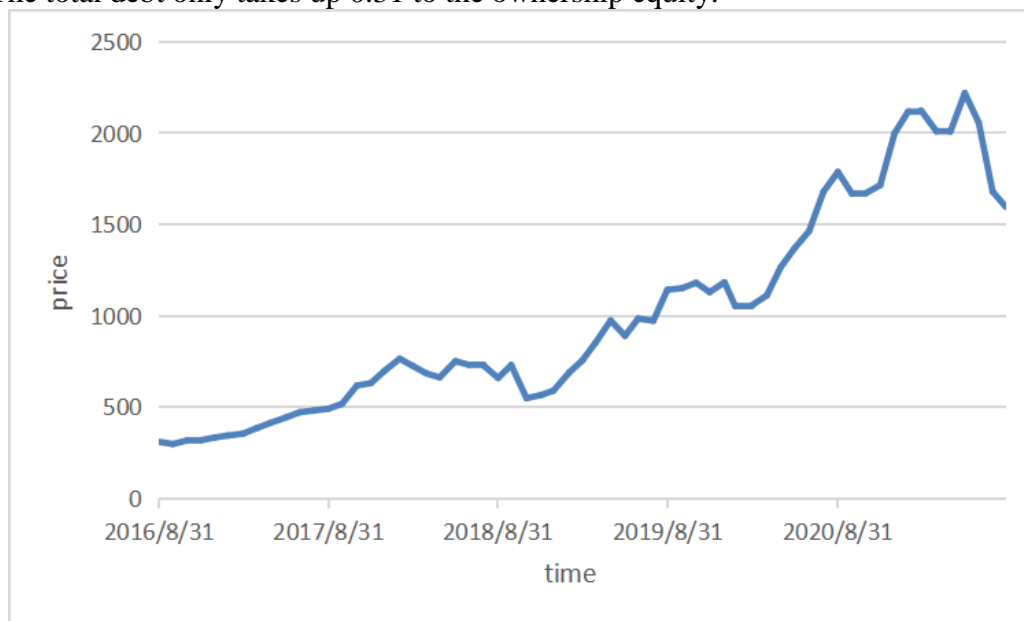


Figure 1. The stock price of Moutai

Nowadays, according to figure 1, Kweichow Moutai company's stock price is 1702.82 RMB per share. The history chart of this stock indicates that this kind of industry is closely related to economic

growth. After 2017, the stock price dramatically grows since at that moment, Chinese spirit industries began recovery in the market and the company promoted international trading. In the last three months, the average volume is 4.63 million. From its beta monthly in the previous 5 years, 0.93, which is smaller than 1, defines that as a low-risk stock.

3. Pricing model

In this part, we simulate the option price according to the Black-Scholes pricing model. Further research has proved that this model assumes future stock prices are lognormally distributed, meaning the future stock price could be represented as a function of “z”. The pricing function is expressed as Equation (1):

$$S_T = S_0 e^{(\alpha - \frac{1}{2}\sigma^2)T + z\sigma\sqrt{T}} \quad (1)$$

Where, S_T means the stock price at time T, S_0 means the stock price at time 0, α means dividend rate, σ means the volatility of this stock.

3.1 Asian option pricing model

Asian option has the same payout as a regular option, except that the underlying is the average of a sequence of daily prices [8-10]. The payout for the call option is:

$$payout_{Asian\ option} = \max(S_{average} - S_0, 0) \quad (2)$$

While the payout for the put option is:

$$payout_{Asian\ option} = \max(S_0 - S_{average}, 0) \quad (3)$$

3.2 European option pricing model

European option calculates the payout using the price at maturity. The payout for the call option is:

$$payout_{European\ option} = \max(S_T - S_0, 0) \quad (4)$$

While the payout for the put option is:

$$payout_{European\ option} = \max(S_0 - S_T, 0) \quad (5)$$

3.3 Simulation

For starters, we collected monthly stock data on Moutai from Aug 2016 to Aug 2021, and find the spot price at 1596.03. Since the term of the Asian option is usually short, we set the Asian option that expires in ten days, with the strike price at 1600. We find the risk-free rate at 1.5%, and use historic data to calculate delta, which is 0.91%. To determine the option price, we stimulate 1000 values of ten days stock price according to its volatility, using the stock stimulation formula in Excel. Then we calculated the corresponding 1000 put and call option values by using the average price in ten days. In contrast, we also calculated the European option price by using the stock price at maturity.

4. Result analysis

The results show that the Asian option price is 21.637 for call and 26.197 for put, while the European option is 37.076 for call and 38.812 for put. To be accurate, we give the maximum error, which is 3.745 for the Asian option and 5.98 for the European option.

5. Sensitive analysis

Now, we can do some sensitivity analysis from the datum calculated before. An Asian option is the option type where the payoff depends on the average price of the underlying asset over a certain period,

while European options' payoff depends on the price of the underlying asset at maturity. This difference in option value will inevitably make these two types of options have different characteristics. Therefore, investors should consider about advantages and drawbacks of each option to choose the most suitable one to invest in.

First of all, from the graph of the sensitivity to sigma, we can find that by using the Asian option, the premium decreases. A larger fluctuation results in higher volatility, and then that leads to the more significant difference between the Asian option and the European option. So, Asian options are cheaper than their European counterparts, especially when the stock price changes a lot. That means that the Asian option can also help people to avoid the effect of any market manipulation, like hyping stocks, insider trading, and so on. This is because when the market price of a stock rise or falls a lot, the changes in average price within a period would be slight.

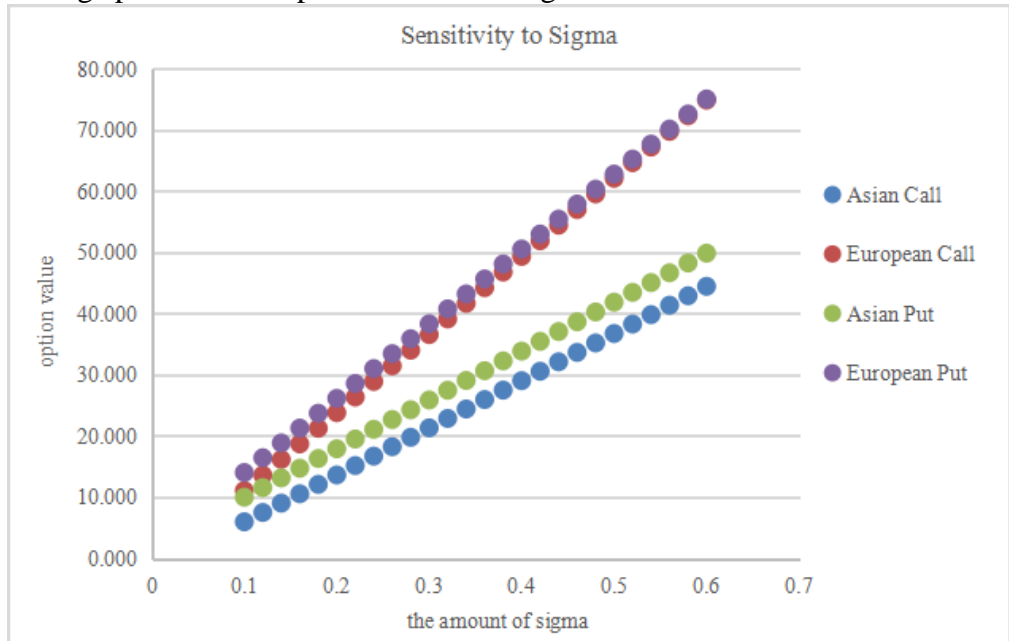


Figure 2. Price sensitivity to sigma

Secondly, we can also find that the relationship between the strike price and option price. Except that the Asian option is cheaper than its European counterparts, we could also find that as the strike price increases, the difference between Asian put and European put reduces, while that between Asian call and European call becomes larger and larger. This is because if strike price stays at a high level, there is less possibility for investors of both types of a call options to gain profit. As a result, the difference between the average possible payoffs of two kinds of call options gets larger. Likewise, this difference would be subtler and subtler when people invest put option. Thus, there would be some suggestions for investors: it is more worth buying Asian calls when the strike price is expensive and buying Asian put when the strike price keeps cheap. If people would like to invest call option with a low strike price or put an option with a high strike price, they should have strong confidence in the stock price to change following their expectation, and then they could invest European option.

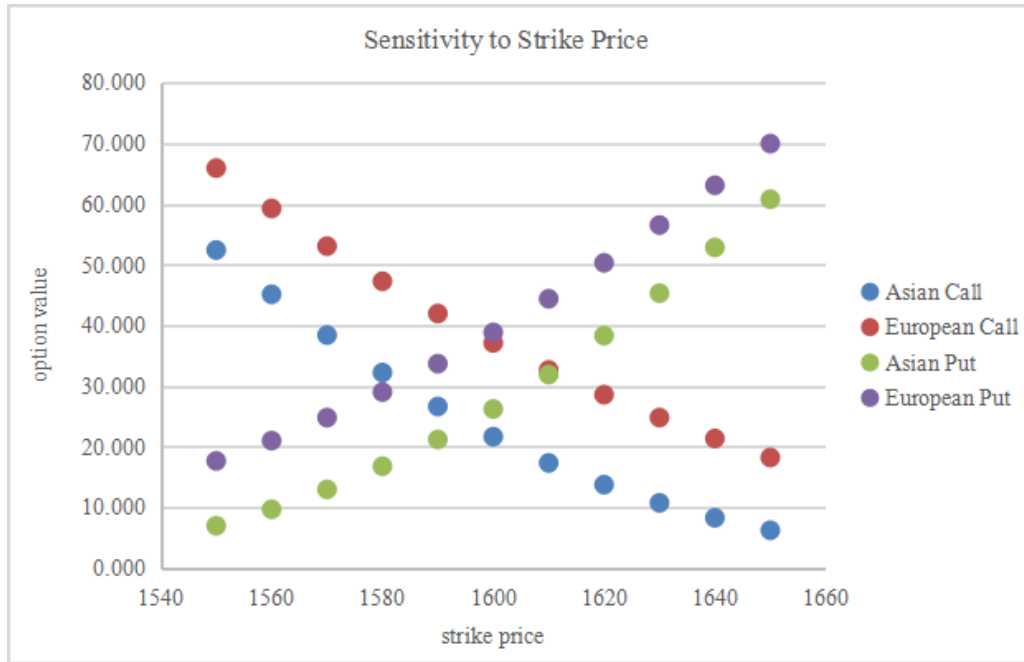


Figure 3. Price sensitivity to strike price

Thirdly, although the free-risk rate has little influence on option value. However, we also can see that when the interest rate increases, the call option premium also increases and the put one decline. This fact shows investors that the call option is a better choice if the free-risk rate is lower than the general value, and vice versa.

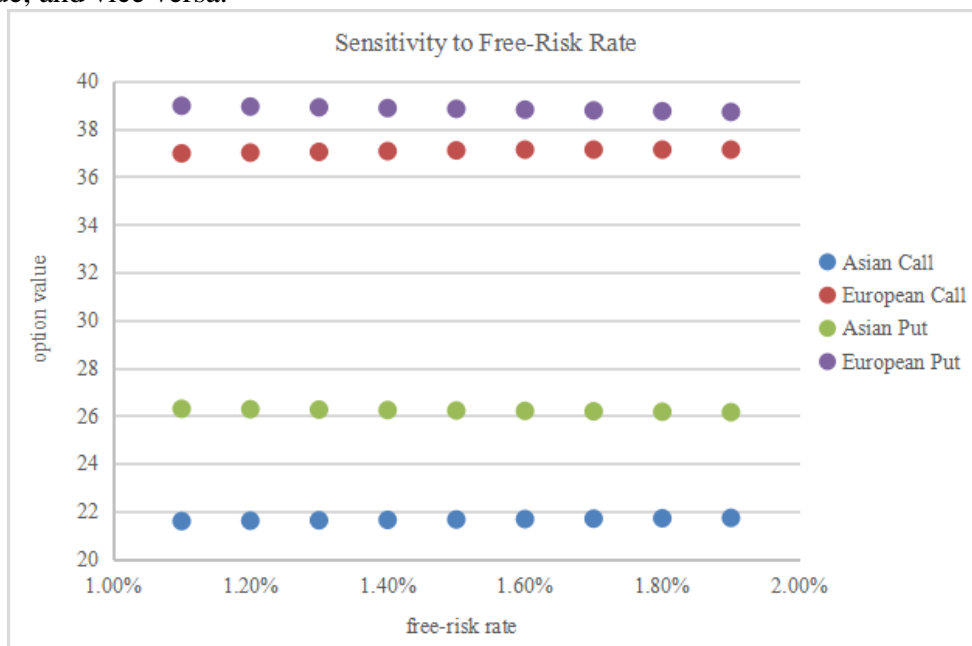


Figure 4. Price sensitivity to the risk-free rate

6. Discussion

As for the types of users and the weakness, the Asian option is suitable for the group of people who need to protect their average cash flow over time. For example, there is a coal corporation that needs to purchase coal every week. Because of the risk that the coal price may go up, the manager wants to buy a call option to hedge the risk. But at this time, the European option is not a good choice, for the simple reason that the final price of the coal is not important, the average price which depends on the prices in every week during the specific period is what they care about. Because of the procurement

plan, the Asian option provides the company with a good opportunity to hedge the risk by buying an Asian call option. The Asian option is also suitable for the people who prefer a lower premium and want to reduce the risk of the high volatility of the price. Because of the lower price and the lower risk, the Asian option is suitable for those people who are risk aversion. The Asian option is suitable for the group of people who want to invest in the thinly traded market when pricing becomes inefficient too. Because of the low liquidity, the average price is more important than the final price. By contrast, the European option is appropriate for the company which plans to purchase or sell the asset on a specific day. In this case, the European option can hedge the risk of a single transaction. The people who are in risk preference may also choose to buy the European option, for the simple reason that the European option can have a higher return rate due to its clearing condition. Under most circumstances, people may prefer to choose the European option, while some corporations with some specific procurement plan may purchase the Asian option to hedge their risk.

When it turns to the weakness of the Asian option, It is difficult for investors to gain a large amount of profit during a short period. As for the European option, there may be some opportunities for market manipulation which controls the final price of the option.

7. Conclusion

In this paper, we take Kweichow Moutai as an example and choose two types of options, the Asian option, and the European option, to research the characteristics of these options. Based on the Black-Scholes model, we figure out the option price and the maximum error of two options, including the call option and put option. Furthermore, we give some suggestions to different kinds of investors to select the most beneficial option for them by doing sensitivity analysis.

From the results, we find that the premium of the Asian option is generally cheaper than that of the European option. Asian option could help investors to avoid manipulation, but it is hard to gain a great amount of profit within a short period. It is more worth buying Asian call when the strike price is expensive and buying Asian put when the strike price remains cheap. The call option is a better choice if the free-risk rate is lower than the general value.

In this paper, we mainly apply the Black-Scholes model in the computing process. However, we should consider the randomness of datum when we use normal distribution in this model, and there would be some limitations since we only choose one single method to do this research. The problems we still should explore are (i). Is there any difference in the result by using other models to process datum, and (ii)? How to apply the Black-Scholes model to the process that stock price is more complex, like trading fees, stochastic volatility model, etc.

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