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Research article

The use of financial derivative tools in the market of construction stones in Lorestan

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English Extended Abstract

Summary

In this research, some options contracts of European and Asian types have been defined for construction stones in Lorestan. The Black-Scholes formula has been used for pricing European options and the Monte Carlo simulation method has been used to calculate the prices of Asian options. The calculation of option prices shows that Asian options have a lower price compared to European options, making them more attractive to investors.

Introduction

Lorestan Province, with 21.5% of the country's construction stone reserves (3% of global reserves) and 22% of the country's production (2.5 to 3 million tons), has high capacities and capabilities for investment in the production and processing of various decorative stones. It is clear that in this industry, obstacles are removed, which can play a significant role domestically and internationally. The use of financial derivative tools, especially option contracts, can play a crucial role in managing the price risks of stone products. This research explores the possibility of establishing option contracts in the stone industry.

Methodology and Approaches

A "Call Option" contract gives the holder (buyer) the right to purchase the asset specified in the contract at a predetermined price E, at the specified time T. A "put option" contract gives the holder (buyer) the right to sell the asset specified in the contract at a predetermined price E, at the specified time T. The specified price in the contract (E) is called the exercise price, and the specified time (T) is referred to as the expiration date of the contract. In standard options trading, there are two types of options: American and European. European options can only be exercised on the expiration date, while American options can be exercised at any time before or on the expiration date. Therefore, an American option gives the holder more flexibility compared to a European option; hence, the value of an American option is higher than that of a similar European option [3].

The Asian option, also known as the average option, is a type of trading option where the payoff depends on the average price of the asset over the duration of the option's lifetime. Since the average price oscillation of an asset is usually less volatile than the moment-to-moment price oscillation, Asian options typically come with lower risk compared to standard European and American options. They often have a lower price as well, making them attractive to traders.

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Another advantage of these contracts compared to European and American options is that in Asian contracts, it is not possible to manipulate the price at the expiration date because the payoff function of the option is dependent on the entire path (not just at a specific time). Asian options are suitable for markets with high volatility and also for markets with low trading volume (low liquidity).

Option contracts for building stones in Lorestan

In this section, European and Asian option contracts on building stones in Lorestan are defined, and fair prices of these contracts are calculated using the Black-Scholes model and then Monte Carlo simulation. The required parameters for calculating the option price will be as follows [1]:

- Risk-free interest rate (r): In this study, the annual bank interest rate of 20% is considered as the risk-free interest rate.
- Price volatility (σ): In this study, the price history of each ton of stone is examined over four years to determine the price volatility during that period. The rocks are of Chinese type and extracted from one of the mines in Dorud County. The prices are shown in Table 1.

Table 1. The price of each ton of stone in thousand tomans

	Farvardin	Ordibehesht	Khordad	Tir	Mordad	Shahrivar	Mehr	Aban	Azar	Dey	Bahman	Esfand
96	600	600	600	650	650	700	700	700	800	800	800	800
97	800	800	800	950	950	1000	1000	1000	1200	1300	1500	1500
98	2000	2000	2500	2500	2500	2500	2500	3200	3200	3200	3200	3200
99	3000	3000	3000	3500	3800	3800	3800	3800	4000	4000	4000	4000

The annual price volatility of stone is calculated as follows

$$\sigma = \sqrt{n}\sqrt{var(\frac{S_{i+1}}{S_i})} \qquad (1)$$

where $\frac{S_{i+1}}{S_i}$ is the ratio of monthly stone price changes and n=12 is the number of months of the year. By calculating the above expression, the variability is equal to $\sigma = 0.3$

- The current price of stone (S) is the price of one ton of stone traded at the end of Esfand 1399 as the cash price of stone.
- The Exercise date (T): In this article, by selecting T=1, contracts with a one-year expiration date are defined.
- The exercise price (E): In this research, various options contracts with different exercise prices are defined as 4000, 4200, 4400, 4600, 4800, 5000.

The buyer or seller of a stone can choose to purchase the desired option based on their prediction of the future price of the stone. The option price is determined using the Black-Scholes model with the above parameters. The results are presented in Table 3. As shown in Fig. 1 and Table 3, the price of an Asian call option is lower than that of a European call option with similar parameters; therefore, Asian contracts may be more attractive to investors.

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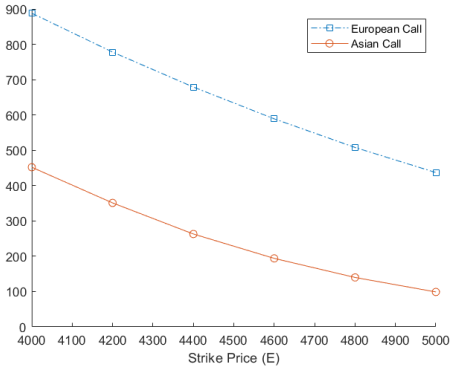

Fig. 1. Comparison of European and Asian call option prices relative to different exercise prices.

Table 3. Price of Asian option contract with a fixed exercise price (simulated by 50,000 samples) and calculation of monthly average price

Exercise price (E)	Put option price	Call option price
4000	102	452
4200	161	351
4400	240	263
4600	334	194
4800	444	140
5000	567	99

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