~~One of the methodologies we have employed for simulating American options is the concept of Least Squared Monte Carlo (LSM).~~  The Least squares Monte Carlo Approach is used for pricing American style options ~~major factor for consideration of the American option is that~~ where the contract holder has the right to exercise the option at any point in time until the expiration date. ~~to sell said contract early if they believe it to be more profitable than at expiratio~~n. ~~This is important to understand and what the LSM takes into account. In this methodology, we are starting wit~~h basic simulation and use Brownian motion to derive all the different paths a stock can take in the future. There in then an iterative process of keeping track of decisions on whether to sell at the current time, or to keep until expiration. The is done by taking only the paths in the money at time t, and using a regression model to calculate the projected payoff would be at the next discounted time increment t+1 and compare to the current payoff at time t. This loops backwards in time and tracks when it would have been earliest optimal to sell for each path. Then based on those optimal time, the paths are discounted to Net Present Value and averaged to get the average option price for the specific contract. For the regression models, we have used a normal distribution model as well as a polynomial model to evaluate the paths future payoff.

Leas Squares Monte Carlo Simulation Method for pricing American-style options by approximating the underlying asset’s stock price, then considering the early exercise of the option at different time points. LSM is best suited for Bermudan-style Options, where the exercise points are pre-defined and fixed. However, as the number of discrete time steps approach 0, the values from the simulation can act as good estimators for the price for the American-style option.

The LSM simulation method solves for the American-style options through a backwards induction process. At each time point, the algorithm finds the optimal decision between immediate exercise price and payoff of the option and the discounted expected continuation value. The discounted expected value is obtained from least squares regression with basis functions.

LSM simulation approaches the true value of an American Option as the number of simulated paths and basis functions increase; however this can be very computationally expensive as the number of simulated paths and basis functions increase.

The Black Scholes model was developed in 1973 by Robert Merton and Myron Scholes, around the same time that options became live in United States markets. The equation estimates the theoretical value of options based on the risk-free rate of return, and the underlying asset, along with time until expiration. The Black Scholes model is still considered one of the best methods to price an option contract today. However, there are some major assumptions proposed by the model. First the model assumes that stock prices follow a log normal distribution that follow a random walk with a constant drift and volatility, no dividends are paid, a constant risk-free rate of return for all maturities, and that there are no costs or restraints associated with trade transactions.

Further Research Opportunities:

1. Find the Expected time of early exercise
2. Standard error of the expected time of early exercise.
3. The probability of early exercise of the option being exercised.
4. Cumulative probability of exercise at each discrete observation

American Options allow the option holder to exercise the option at any point in time until the expiration.

Bermudan Option are a restricted form of the American Option. The Bermudan Option allows the option holder to exercise the contract early, but for a predefined set of dates.

Asian options depend on the average price of the underlying asset over a certain period of time. This is different from American and European options where the payoff depends on the price of the underlying asset at a specific point in time.

**Variance Reduction:**