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What if I told you there is a market that currently handles over 7 times the entire world’s GDP? A market that has been growing steadily in recent decades, having peaked in 2013 handling over 700 trillion US dollars in that year alone. Hard to believe, right? My name is Miguel Ribeiro and I’m here to present: Derivatives.

So, what are derivatives? In finance, a derivative is simply a contract whose value depends on other simpler financial instruments, like stock prices or interest rates.

I’m doing my master thesis on the most traded type of derivative: options. With an option, I pay a price for the right to buy or sell an asset for a fixed price in the future. Let’s see an example. Imagine I’m a farmer and I believe that this year the yield of one of the crops I produce will increase nationally. With the increased offer, the prices of that crop should go down. By signing an option, I fix the future price at which I can sell my crops, thus selling them at a higher price.

The main advantage of options is that if my prediction proves wrong and the crop price rises instead of going down, I can let my option expire and still sell my crops for their higher market value, though I lose my option investment.

This example can be extrapolated for virtually all assets. I’ll focus particularly on stock options that deal with stocks instead of crops.

Now, the great question is: How much should you pay for an option? This problem has troubled investors for many decades and no analytical solution exists so far. We currently depend on heavy numerical methods to price options, that only approximate the ideal result.

Black, Scholes and Merton came up with a result that has been heavily used to simulate stocks. This is their magical equation. Solving it iteratively we obtain a simulation of a stock price path.

The stock price depends on the risk-free interest rate, r, a normal distributed random variable, N, and the volatility of the stock price, sigma, which measures how uncertain the stock price movement is in the future.

By simulating a very large number of stock price paths, we can observe some underlying behaviors of the stock and then predict the price of an option on that same stock, using a numerical algorithm developed by Longstaff and Schwartz.

Despite its simplicity, this method makes some assumptions on the behavior of stock prices, such as constant volatility and interest rate, which do not hold in the real world. One of the goals of my thesis is to replicate this algorithm and then make some adjustments to the simulations to better replicate real-world stocks.

Despite our efforts, our model will never be perfect, and one of the main problems in option pricing is associated with the uncertainty of some of the model inputs. We can’t precisely measure the volatility of a given stock price, nor its risk-free interest rate. For this reason, the output of our model will have an associated uncertainty.

Though we can never completely get rid of the output price uncertainty, we can still study which factors contribute the most to it, and by how much. It might happen that a small variation on the volatility will produce a large variation on our output, and therefore we should invest more resources in the mitigation of the uncertainty of that variable to obtain a price with less variance. On the other hand, if this variable barely influences the option price, we may ignore it altogether.

This information is particularly important for investors because they learn where to apply their resources. For this reason, this analysis will be one of the main goals of my thesis. I hope I spiked your curiosity, thanks for watching.