**Literature Review**

**Adam’s Lit Review**

1. **Modeling and Simulation of an Artificial Stock Option Market**
   1. <https://link.springer.com/article/10.1007/s10614-008-9134-6>
   2. The structure of our model is characterized by a market in which N agents trade a single stock, that pays no dividends, in exchange for cash. There are no transaction costs or taxes. Each trader is modeled as an autonomous agent and is characterized by a wealth, constituted by the sum of her cash and stocks, valued at the current price. Traders’ initial endowment—both in cash and stocks—is obtained by dividing agents into groups of 20 traders, and applying Zipf’s law to each group (Mannaro et al. 2007), so that the difference in wealth among the richest and poorest traders at the start of the simulation is about twenty-fold. Each trader is given an average $50,000 cash and 1,000 stocks.
   3. The option market has in fact only a slight effect on the stock market, and this amounts to just a small decrease of price volatility when options are traded. We then studied a more complex and realistic stock market model, where different kinds of trading strategies are applied. We gave to a percentage of the traders the ability to use “Straddles”, or to use options to cover their positions. In practice, the options are used to stop the losses in the case prices variations are against the buy or sell transaction performed by traders. In the case of “Straddles”, we observed a significant increase of price volatility.
2. **Using least-square Monte Carlo simulation to price American multi underlying stock options**
   1. https://ieeexplore.ieee.org/abstract/document/7231476
   2. This research uses Least-Square Monte Carlo (LSM) method to estimate American put option price. Firstly, LSM method is applied to determine single asset of American put option price and its optimal exercise boundary.
   3. Monte Carlo simulation concept mostly uses the mean of simulation data to approach a value. In this case, computation of the estimated price of the option in case of a neutral risk is conducted through a random sampling which was then discounted at the risk-free interest rate
3. **Presence of Informed Trading In Options Markets: An Experiment Using Monte Carlo Simulation**
   1. https://scholars.fhsu.edu/jbl/vol1/iss1/4/
   2. Using Monte Carlo Simulation we show that informed trading takes place in the options market. Our results indicate that at-the-money option contracts are less likely to be information based trades.
   3. Traders with valuable private information find the options instruments more attractive than its underlying due to the leverage effect.
4. **Optimal Stock Option Trading Strategies**
   1. <https://www.research-collection.ethz.ch/handle/20.500.11850/593456>
   2. The main goal of my internship was to create some predictions and optimizations in Python based on known simulations such as Monte-Carlo. Initially, I mostly studied the theory under prediction methods as well as neural networks. Indeed, these are really needed in predictions. Then, I developed my research by creating my own prediction model codes. Finally, I work on the optimization of the wealth of a portfolio by following the evolution of a market.

Ryan’s Lit Review

1. **Option Pricing using Monte Carlo Simulation**

* [sas\_Vol2\_No4\_65-79\_Martinkute-Kauliene.pdf (vilniustech.lt)](https://etalpykla.vilniustech.lt/bitstream/handle/123456789/142386/sas_Vol2_No4_65-79_Martinkute-Kauliene.pdf?sequence=1&isAllowed=y)
* Uses Monte Carlo simulation in MatLab to predict prices for vanilla options. The prices were then compared to actual prices and prices obtained with Black-Scholes framework.
* Has a great overview of option pricing and calls and puts
* A paper with math equations and formulas

  Description automatically generatedIn Matlab, Monte Carlo simulation was only off by a few tenths when simulating option prices for weekly, monthly, and 50 day intervals (works for medium and short periods)
* Monte Carlo simulation can sometimes be more accurate than analytical Black-Scholes model for longer time horizons
* Simulation is good for modeling stock options because it can handle uncertainty in an easy manner

1. **Stock Option Pricing by Augmented Monte Carlo Simulation Models**

* [Stock Option Pricing by Augmented Monte-Carlo Simulation models (iau.ir)](https://sanad.iau.ir/journal/amfa/Article/670650?jid=670650)
* Estimated prices of stocks traded on Tehran (Iran) Stock Exchange using several variations of Monte Carlo simulation: classic, control variates augmented Monte Carlo, antithetic variate augmented Monte Carlo
  + Follow European stock option model
* Compared results with hopes of minimizing the standard error of price estimates
* **Control variate augmented method** performed best since it had estimates that wee closest to market stock option prices and had the highest explanatory power
* Antithetic variate augmented method had lowest standard error, but values farther from actual market values
* Control variates: a method of variance reduction which uses a correction factor depending on the distance between the control variate and its expected value
* Antithetic variates: a method of variance reduction that relies of pairs of randomly generated numbers with a negative correlation that should result in pairs of negatively correlated simulation numbers. The average of the numbers produced by each number pair is then taken
* A stepwise regression procedure was performed to determine which model’s price estimates were most correlated with market prices (r-squared is the quality metric)

1. **Estimating option greeks under the stochastic volatility using simulation**

* [main.pdf (sciencedirectassets.com)](https://pdf.sciencedirectassets.com/271529/1-s2.0-S0378437118X00090/1-s2.0-S0378437118309798/main.pdf?X-Amz-Security-Token=IQoJb3JpZ2luX2VjEAEaCXVzLWVhc3QtMSJIMEYCIQCmTxPZ4y14Kfu08X66Bv2sxM3wlDIHyKqX9HZlqpjGfgIhAKiteJPVuybgv9KIBnYMW3Su9YnPiaEWcQ4oFKtJzgpmKrwFCKr%2F%2F%2F%2F%2F%2F%2F%2F%2F%2FwEQBRoMMDU5MDAzNTQ2ODY1IgzU7SkLgRQ3KQZcojIqkAWnNYV%2BkJzbVRe665P2yhbJQ3gX6g8SZ%2BTzpWSyyx5fExxgmJ%2FioMp3Zc1R2GQmyruzXhfFXR9BqUZhaKGMomCovcJyWLAPfjoNCqSEWmRVUo%2Fph9BQWqVHAQbMjzx9L8n3wYY3iPQd1SSsFBu32gLcMpgU1pTHbFcgmc3y3BCZaVVKQis30ZhpbphKXpS5MSyYit9fcL0mno6xCSKOT8CaZAlT6bLJZVBhDn6NQwNh9MIRtWdjzw9bEV5YCfhez7rYV3duAElQVb3Wb3Cag%2B2ki5VgTsEqAuGv0hOziYk1HYHqBk0A8BqZnbvHmAQalg8JB3wDjyq61ZjAtMOrhan0EZ2LIvEbiqQuP99lruTfgwKlk3IEmC7WdAzyEn%2BzkeEOGVp2vDiKYjODb9XSoVJJMwuZiDcJAnyEFUaJS13wak1mRqP6haauMmh%2FfTeVPLZxOhW4%2BlXWdBDPm8B1i5NmMlMSPfTbg6PxCFw7ldliv1smXi%2FTIE%2BJWDfdZoZWKtQpGBmcfsaY3rOMJZsWK4mOv8iG5Q5vPk5041VJ97h%2F741%2Fz1wXmYkNsI3ywc1KxtqpSi6LqEgFMaWGHnbiEGwZO%2FEQSVcrWnvzh34Yrc5xk1FrVJqqJUzw%2Bg%2BXw6AmSRPEKoaob2cobUdzMeYejT364iXKr%2Fz0zymTqzNqKRUYCaxoEKEe2uvfQXqSnPahPkfAp3ph5AlMbCfzm3uVBL7YpReV4wdMYIqDA270UIsYrL0xm5wAnW7ShO0famlGHjjL9Gb5zQCacb%2F4nqIpzgMmgnHu%2B21W07VsBiVoX2R2qKgD%2Byb0MPBEv1noMZViGodqaBDTuWXOBNcNX1CGh08Dsw8mxK%2FnNzJxyBhpt4z0WTDmy%2BazBjqwAffqGX0aFCTlI4opYWxkeUO%2F1xdnTqvbLuLLAuCuffIMyOcljya5lCJSiJNQoYsee1ypByMiAQYNTZJOGryJshx1hn9S37MY%2BorIy%2BJkw00OKR0JszxIx8c37ZPGwlBxN0bev88O%2FkNBukEKnD7lxLr1q50kGS8NJR1NrU%2B3pJTdFPiaMNwf8rYzf3J4eSazqqBYumQssT9heYfzVSPM6NEswdR3FCINbOrToCs58fdz&X-Amz-Algorithm=AWS4-HMAC-SHA256&X-Amz-Date=20240624T180331Z&X-Amz-SignedHeaders=host&X-Amz-Expires=300&X-Amz-Credential=ASIAQ3PHCVTY5RSZ6H7Q%2F20240624%2Fus-east-1%2Fs3%2Faws4_request&X-Amz-Signature=7c6a3a6c71fde56e03e759713165e86855949558db96560f9c211273c0fcbe16&hash=e0f91ea4768ff26599924949bde9eca6011d7f4ca64342553db025b1c8fb2f7c&host=68042c943591013ac2b2430a89b270f6af2c76d8dfd086a07176afe7c76c2c61&pii=S0378437118309798&tid=spdf-fc10689b-59ed-4b20-a757-da18a3116bb2&sid=83260d126574a14588-8da4-3df19f931a5agxrqa&type=client&tsoh=d3d3LnNjaWVuY2VkaXJlY3QuY29t&ua=131)
* Aimed to price European call options
* Used both likelihood ratio and path-wise approaches to generate derivatives of option price equations, which can provide unbiased estimates of the Greeks
  + 1st order derivative with respect to price: delta
  + 1st order derivative with respect to volatility of underlying: vega
  + 2nd order derivative with respect to price of underlying: gamma
* A stochastic volatility model (Heston 1993) used to simulate European stock option prices and variance
* Used three models:
  + Stochastic volatility model
  + Stochastic volatility model with jumps in stock price (generate Poisson random variable)
  + Stochastic volatility model with simultaneous jumps in price and variance (generate Poisson random variable)

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* Path-wise:

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* Likelihood ratio:



* Stock price could be expressed as a series of lognormal random variables
* An exponential model was appropriate for modeling European stock options

1. **Simulated Greeks for American Options**

* [Simulated Greeks for American options (tandfonline.com)](https://www.tandfonline.com/doi/epdf/10.1080/14697688.2022.2159869?needAccess=true)
* Estimate prices and Greeks for American options (allow for early exercise) simultaneously
* Done using a 2-stage procedure that combines simulation and regression-based Monte Carlo methods along with a choice of optimally dispersed state variables that seek to balance bias and variance of estimates
* 2 stage procedure:

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* Estimate of optimal stopping time:

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* Generating the random sample:

A math equations and formulas

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* Method automatically chooses initial dispersion of state variables
* Method was more precise than likelihood ratio and path-wise methods (lower bias and similar standard deviation) and robust at a wide range of paths and initial state dispersions

Vinson’s Lit Review

1. Monte Carlo Simulation for Option Pricing with Python[URL](https://github.com/TheQuantPy/youtube-tutorials/blob/8e64e19629cee840928b51baf4660e5c777e87e7/2022/001%20Jan-Mar/2022-01-19%20Monte%20Carlo%20Simulation%20for%20Option%20Pricing%20with%20Python%20(Basic%20Ideas%20Explained).ipynb)
2. Trading stock volatility with the Ornstein-Uhlenbeck process [URL](https://github.com/TheQuantPy/youtube-tutorials/blob/8e64e19629cee840928b51baf4660e5c777e87e7/2022/001%20Jan-Mar/2022-03-08%20Trading%20stock%20volatility%20with%20the%20Ornstein-Uhlenbeck%20process.ipynb)
3. Stochastic Calculus for Option Pricing [URL](https://www.youtube.com/watch?v=NgLiUS3NdIU&t=195s&ab_channel=QuantPy)

Ben’s Lit Review

* [Youtube](https://www.youtube.com/watch?v=pR32aii3shk&ab_channel=QuantPy) video walking through Monte Carlo Sim for Option Pricing in Python
* Another Short [article](https://scribbler.live/2023/05/04/Monte-Carlo-Simulation-for-Option-Pricing.html) on option pricing using simulation
* [A Long Article on option pricing via monte carlo simulation](https://www.tejwin.com/en/insight/options-pricing-with-monte-carlo-simulation/)
* Github of someone's python code for pricing [options](https://github.com/hongwai1920/Implement-Option-Pricing-Model-using-Python/blob/master/1.%20Pricing%20of%20vanilla%20options%20in%20the%20Black-Scholes%20world%20and%20Monte%20Carlo%20Simulation.ipynb)
* [Black Sholes Model and the Greeks](https://medium.com/tej-api-financial-data-anlaysis/quant-black-scholes-model-and-greeks-f00dc82bcb81) implementation on Medium