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Optimal Portfolio Using a Genetic Algorithm

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Introduction

Portfolio optimization is one of the main financial investment decisions. Distributing the amount of money to invest in each stock of a portfolio, while **maximizing return and minimizing risk** is even more complicated. A **genetic algorithm** will be utilized in order to accomplish this task. A **fitness function** will determine the effectiveness of the portfolio distribution. A **five stocks, five years portfolio** example is used to illustrate the applicability and efficiency of a genetic algorithm. A **crossover** will be applied in order to see how the genetic algorithm converges towards the optimal solution. The crossover, in combination with the fitness function allows the best distributions to merge in order to form even better distributions.

Genetic Algorithm in Finance

A genetic algorithm generates solutions to optimization problems using techniques inspired by natural evolution. In summary, it produces a random population, where the individuals are **portfolio distributions** in this case, evaluates the fitness of all distributions, selects the **fitter distributions**, merges them and creates the new, desired and **best distribution**, the **optimal portfolio**. A distribution that maximizes return and minimizes risk.

Data

Mean return for each stock

Stock 1 (Tech)	Stock 2 (Financial)	Stock 3 (Consumer)	Stock 4 (Health)	Stock 5 (Industrial)
0.2352	0.0722	0.2491	0.1339	0.1259

Fitness function

The expected return of each stock *i* is $\mathbf{E(d_i)=d_i \cdot r_i}$ where d_i is the distribution of one stock and r_i the expected return. Therefore, the total expected return of the portfolio is $\mathbf{F= \Sigma E(d_i)}$, which will be maximized. In order to minimize risk the final fitness function is $\mathbf{H(d_i)= F(d_i) - \sigma^2(d_i)}$ where $\sigma^2(d_i)$ is the portfolio variance.

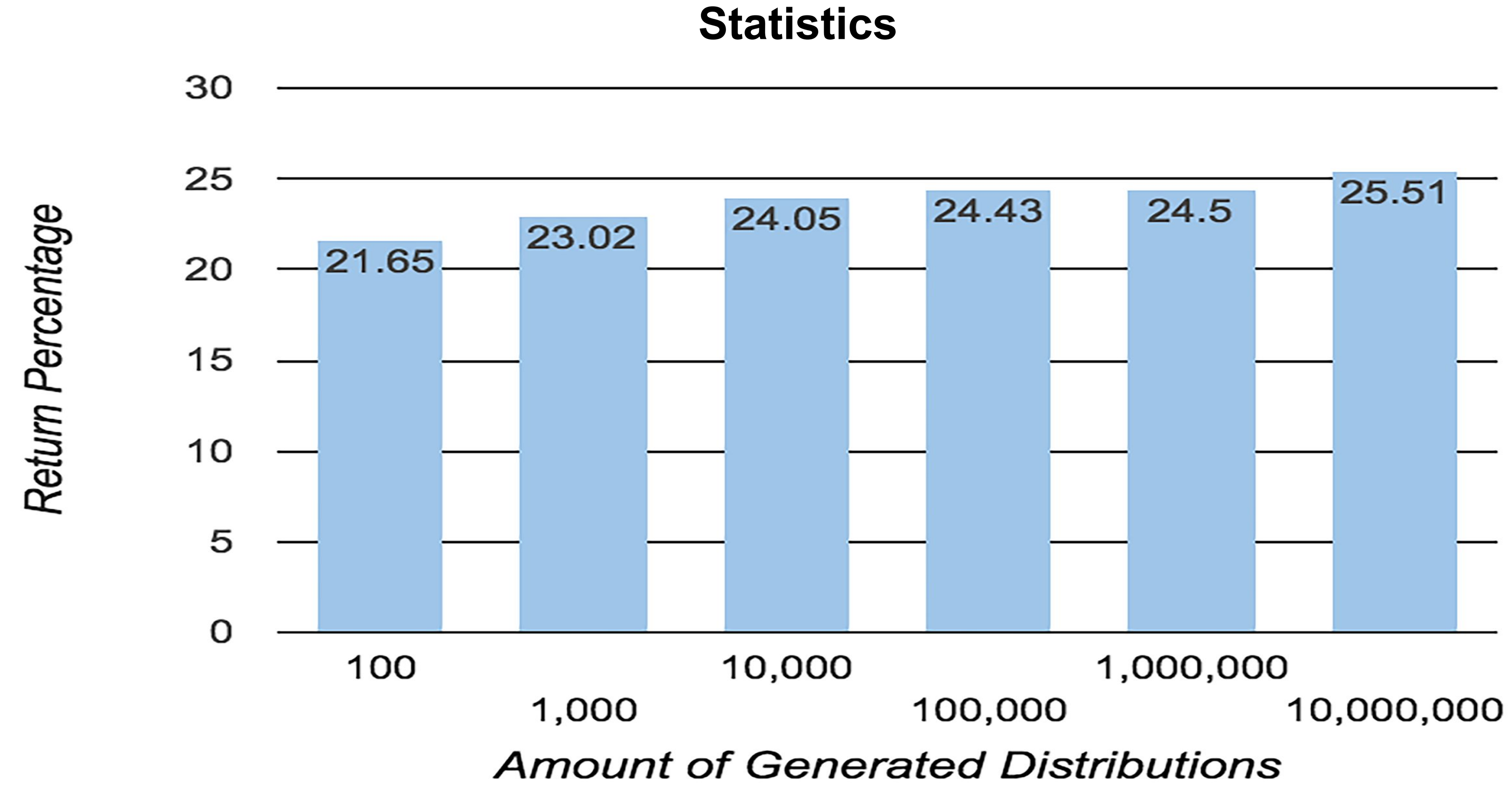
Results

Optimal Portfolio Distribution

Stock 1 (Tech)	Stock 2 (Financial)	Stock 3 (Consumer)	Stock 4 (Health)	Stock 5 (Industrial)
0.2127	0.0016	0.7798	0.0024	0.00308

Average Return	0.245
Fitness Value	1.105
Computing Time	11 minutes and 37 seconds

Statistics



Conclusion

The genetic algorithm method was applied in order to find an optimal portfolio with the best distribution, which maximizes profit and minimizes risk. The method was applied on a five stocks throughout five years portfolio. The results obtained confirm the **efficiency** of the genetic algorithm for its convergence towards the better solution and interesting computing time. The best portfolio distribution provided by the genetic algorithm produced a **25% return**. Also, it was shown that the bigger the population, in this case distributions, the more accurate the results. The greatest return was produced when **10 millions of distributions** were generated, but the computing time was **more than an hour**.

References

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