The purpose of this simulation is to model a retirement contribution plan from age 25 to 65 with no previous contributions. The goal of this model is to determine the amount needed to invest to have 1.5 million dollars by retirement age before taxes. I want to use as realistic assumptions as possible as I am going to use this model for personal financial preparations. I chose systems analyst as the career used to determine starting salary. I used a normal distribution to model fund growth. Accompanying that is a constant fund fee that will incur a small percentage of the fund’s total investment annually to maintain the fund. For salary growth, I used a uniform distribution of 0 to 5 percent growth from year 1 to year 10, and then a uniform distribution from 0 to 2.5 percent growth from year 11 to retirement. The reason for this is to give a more realistic version of salaries since inflation is not included in the salary calculation, even though the growth rate for the investment portfolio does account for inflation. I set three different investment proportions to determine the minimum necessary investment rate, as calculated as a percentage of salary, to reach my goal- 10 percent, 7.5 percent, and 5 percent. Using data table, I ran 100 simulations for each investment rate and gathered summary statistics.

First is to include the constants in the project. The starting salary I am choosing for this project is $79,412. That is the average starting salary for someone with 0-1 years of experience in Huntsville, Alabama. I am assuming that the investor has no prior investment as all of his previous earnings have been stripped by the high costs of the higher education system. The expense ratio will also be constant at .4 percent of the total portfolio value.

I am going to use the 30-year inflation-adjusted average rate of return of 8.1%(<https://seekingalpha.com/article/4502739-average-stock-market-return>) for the S&P 500 index. The purpose of using the 30-year average rate instead of a 10- or 20-year average rate was so that I could get the longest timeline possible since this is going to be a long-term investment of 41 years. I included a normal distribution to add the natural variance of market conditions. I chose the standard deviation of 0.05. The following is the resulting distribution that mimics the growth rate of the portfolio.

|  |  |
| --- | --- |
| Summary Statistics | |
| Avg | 2827987 |
| SD | 711498.6 |
| Min | 1413331 |
| 1st Quartile | 2343067 |
| Med | 2756867 |
| 3rd Quartile | 3181789 |
| Max | 5914025 |

10 percent

|  |  |
| --- | --- |
| Summary Statistics | |
| Avg | 2127514 |
| SD | 488339.5 |
| Min | 1250264 |
| 1st Quartile | 1765775 |
| Med | 2058783 |
| 3rd Quartile | 2520631 |
| Max | 3383652 |

7.5 percent

|  |  |
| --- | --- |
| Summary Statistics | |
| Avg | 1398263 |
| SD | 344644.8 |
| Min | 857211.3 |
| 1st Quartile | 1110670 |
| Med | 1380066 |
| 3rd Quartile | 1603069 |
| Max | 2541496 |

5 percent

These three charts represent the summary statistics of the percentage of income contribution of 100 simulations. As you can see, the only contribution percentage where the expected amount is less than the goal amount is in the case where the contributions are equal to 5 percent. This suggests that the income percentage contribution where the mean is at 1.5 million is somewhere between 5 and 7.5 percent. That being said, if 7.5 percent is the highest percentage of your income that you can afford to contribute, in over 75 percent of cases you will be fine. Same goes for 10 percent, but even more so. In my opinion, the more that you can save, the better.

This project assumes a normal distribution for portfolio growth because the stock market does not follow any one distribution. Another assumption that may not be entirely accurate and is used to simplify the problem is the growth in salary. A uniform salary growth not realistic, as wages can stagnate in years not including a promotion or bonus. Sometimes, even with a wage increase, these increases do not keep up with inflation. Inflation was another factor that was not considered completely in this analysis. Another factor that was overlooked was the increased benefits of a 401k and employee matching. These kinds of incentives can drastically boost investment contributions without negatively affecting your taxes.

Considering these results and some of the assumptions made for this project, we can conclude a few things. One, you may not get to experience the growth in salary that our subject did. However, even assuming you did, it would be an excellent idea to save at least 7.5 percent of your income, or an equivalent with employee matching to a low cost index fund account. This gives you at least a 75 percent chance of retiring with at least 1.5 million following the simulations assumptions. Even 2.5 percent less than this and you can end up falling below your target. 1.5 million sounds like a lot, but when you consider that the average lifespan in the U.S. with a college degree is nearly 85 years, that leaves you with only 75000 per year before taxes! (<https://www.economist.com/graphic-detail/2021/03/17/educated-americans-live-longer-as-others-die-younger>)

Chart, line chart

Description automatically generated