TODO: Add Graph of Probabilities vs Time for 15 through 30 years

# Achieving Financial Freedom

* Estimate the probability of reaching an accumulation goal
* Demonstrate the approach using a fictional narrative
* Provide links so you can input your own goals and investment assumptions into the calculator

**Summary:** Robert is a 22 year old investor who wants to estimate how long it will take him to achieve financial freedom. To do so, he calculates the probability of reaching his goal of accumulating $3 million for multiple time periods using this [investment calculator](https://poppertech.com/choosing-investments-based-on-retirement-goals). You can upload your own cash flow and investment assumptions by following [these instructions](https://poppertech.com/instructions). The calculator is free to use and requires no personal information. Please feel free to share your modifications in the comments section below as well as any questions you may have.

**The Investor:** Robert is a 22 year old management consultant who wants to achieve financial freedom. Specifically, he believes that if he accumulates $3 million in assets, money would no longer be the primary factor in any major life decision. He wonders: if he invests all of his disposable income, how long will it take him to reach this target?

Robert’s employer pays for an investment adviser, Jim, to guide employees in their 401k allocations. Jim explains that as a general rule, higher risk investments generate higher returns. Also, investors who are closer to retirement or have short-term cash needs may have less of an appetite for risk. This makes sense to Robert and suggests that he has a competitive advantage over some of the older employees. He has a time horizon that is measure in decades and no foreseeable cash needs. Therefore, he is in the position to take the maximal amount of risk and reap the rewards in the long term.

Robert asks, “Which of the 401k options has the highest risk-reward profile?” Jim explains, “The Emerging Markets Equity Index has historically had both the best and most volatile performance.” His decision made, Robert starts to prepare the data required for his calculations.

**Cash Inflows:** Robert currently earns $80,000 per year. He plans to contribute $20,000 to his 401k before tax. He also assumes a 25% effective income tax rate. Therefore, he will net $45,000 after tax. He lives modestly and should spend about $25,000 on housing, food, and entertainment. This leaves another $20,000 that he can invest after tax. In addition, he assumes this amount will grow at 4% per year, or roughly twice the inflation rate, because his compensation should outpace his cost of living.

**Portfolio Allocation:** Much to Jim’s dismay, Robert intends to allocate both his 401k and after-tax funds to the Emerging Market Fund. Jim tries to dissuade him from this plan and explains the benefits of diversifying across both developed and emerging markets, but Robert counters that the Emerging Market Fund spreads risk among different countries, industries, and stocks. Besides developed and emerging markets are becoming increasingly correlated. Why not just pick a diversified fund with the highest potential gain?

**Investment Forecast:** Robert needs to simulate the growth of his investments over time and compare the accumulated amount versus his $3 million goal. To simulate his investments, he creates a long-term forecast for their growth. He starts with historical data for the IShares MSCI Emerging Markets ETF (EEM) from the last 16 years as a baseline and then alters the forecast based on his judgment to create a realistic prediction. To start, he determines the Minimum, 10th Percentile, Median, 90th Percentile, and Maximum values of the annual percentage gains and losses of the ETF. Table 1 shows the results:

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Minimum | 10th Percentile | Median | 90th Percentile | Maximum |
| -48.9% | -17.7% | 16.5% | 35.7% | 69.0% |

***Table 1: Summary statistics from annual percentage gains and losses of the IShares MSCI Emerging Markets ETF from 12/31/2003 through 12/31/2018 (Daily Adjusted Prices from Yahoo Finance)***

In addition, he calculates the Mean, Standard Deviation (Stdev), Skewness, and Kurtosis of the above dataset as well. This yields the results in Table 2.

|  |  |  |  |
| --- | --- | --- | --- |
| Mean | Stdev | Skewness | Kurtosis |
| 11.2% | 29.3 | -.154 | .273 |

***Table 2: Descriptive statistics from annual percentage gains and losses of the IShares MSCI Emerging Markets ETF from 12/31/2003 through 12/31/2018 (Daily Adjusted Prices from Yahoo Finance)***

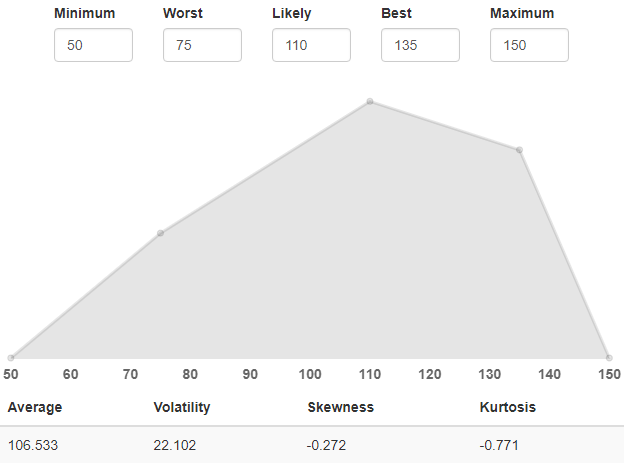
Robert reasons that the future gains and losses for Emerging Markets will not match the past for the following reasons:

1. The past performance was extraordinarily positive, and it would be difficult for countries such as China to continue growing at the same rate going forward.
2. Emerging markets were far less developed 15 years ago than they are now. Therefore, future performance should not be quite as volatile.

To alter this baseline forecast to fit his beliefs, he performed the following steps:

1. He assumes the Minimum historical performance is a reasonable estimate of the future.
2. He predicts the Maximum historical performance is unlikely to reoccur and forecasts the Maximum possible gain mirrors the Minimum possible loss.
3. He assumes the 90th percentile performance of 35% is representative of the future.
4. He forecasts the future Median performance will be lower than in the past
5. He predicts that the 10th percentile performance will be worse than the historical period.

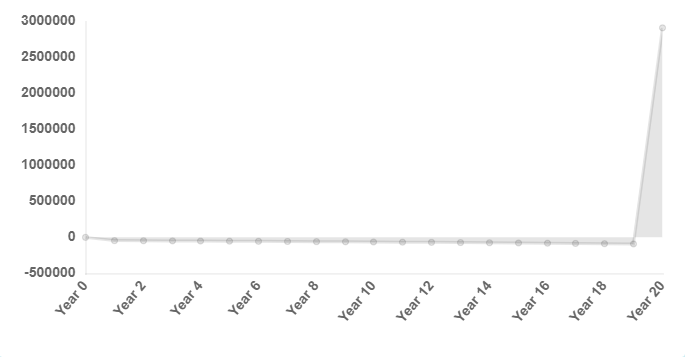
**The Investment Software:** After performing these steps, Robert enters his estimates into the Probicast software. The software draws the probability distribution shown in Graph 1:



***Graph 1: Estimated annual long-term forecast for Emerging Markets assuming a current price of 100. The software generates the above graph based on the input scenarios and interpolating straight lines between each scenario.***

Each scenario is connected to the next with a straight line. Probicast generates 1 million random numbers meant to simulate probabilities and maps them to simulated prices based on the above graph. For example, simulated probabilities of 0, .5, and 1 would map to 50, 105, and 150, respectively.

He also adds his aforementioned cash flow assumptions. Since cash outflows are positive in the application by convention, he enters his income as negative numbers. To calculate the probability of reaching $3 million in 20 years, he adds this figure to his negative income in 20 years. The result is shown in Graph 2.



***Graph 2: Projected cash outflows versus time over the next 20 years. Annual income is negative. $3 million dollars is added to income in year 20 to simulate the goal of reaching the accumulation target.***

**Results:** Based on the above inputs, Robert calculates a 25% probability of accumulating $3 million in 20 years.