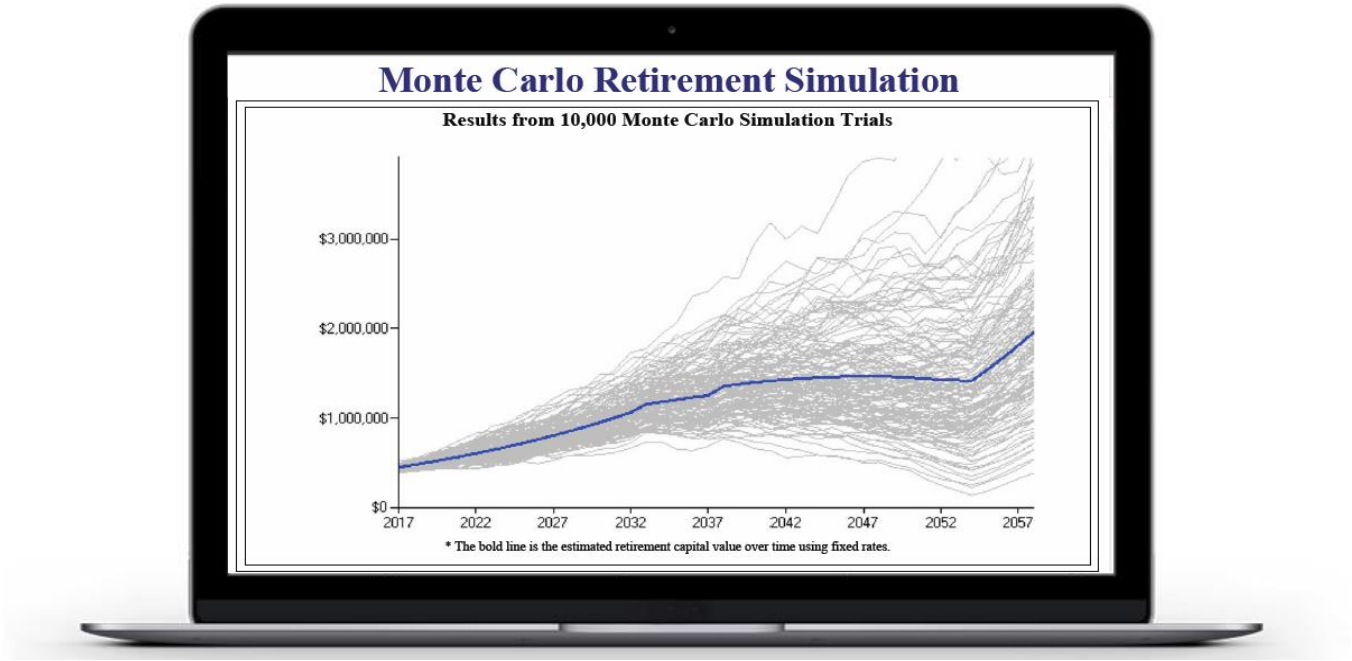
Monte Carlo Introduction



Probability Based Modeling Concepts

What is Monte Carlo?

Monte Carlo Simulation is the currently accepted term for a technique used by mathematicians and engineers to find probable answers to highly complex and unpredictable equations.

A large number of random trials are run. Patterns in the trials outcomes show the most likely range and concentration of results.

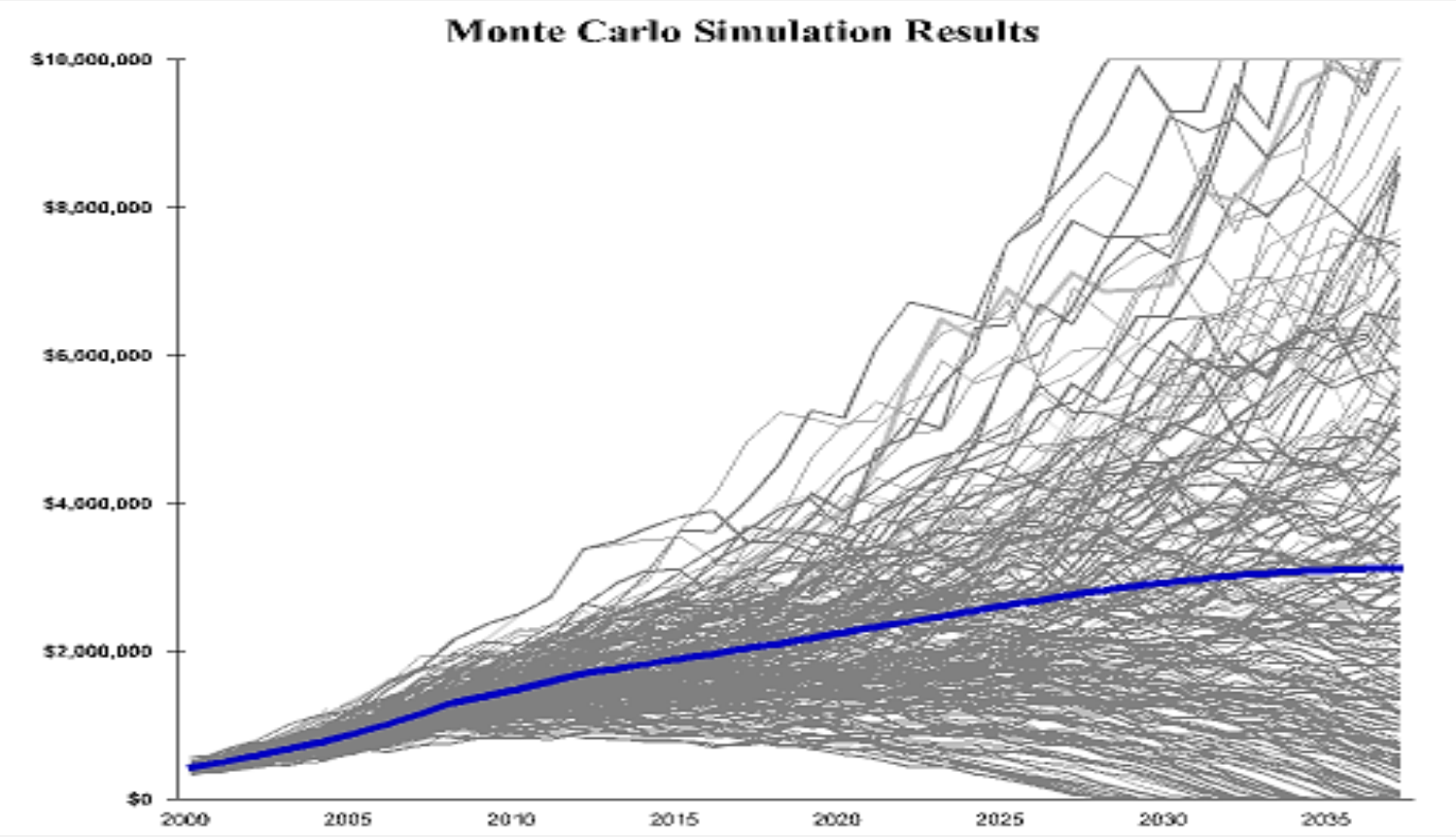
How does Monte Carlo work?

- Mathematical Models are Used to Reflect Future Reality
- Variables in the Model allow for Future Uncertainty
- Probability Concepts Create Random Trials in the Model
- Large Number of Random Trials are Run for Analysis
- Patterns of Results Demonstrate Trends and Certainty
- Statistical Results Measure Distribution and Range
- Graphs Help Illustrate Variability and Show Patterns

1000 Simulation Results

Results of 1000 Simulations:	
Percentage of projections above zero	84%
Retirement Projection Estimate	$3,123,022

Minimum Monte Carlo projection	$0
Average Monte Carlo projection	$3,165,938
Maximum Monte Carlo projection	$20,351,776



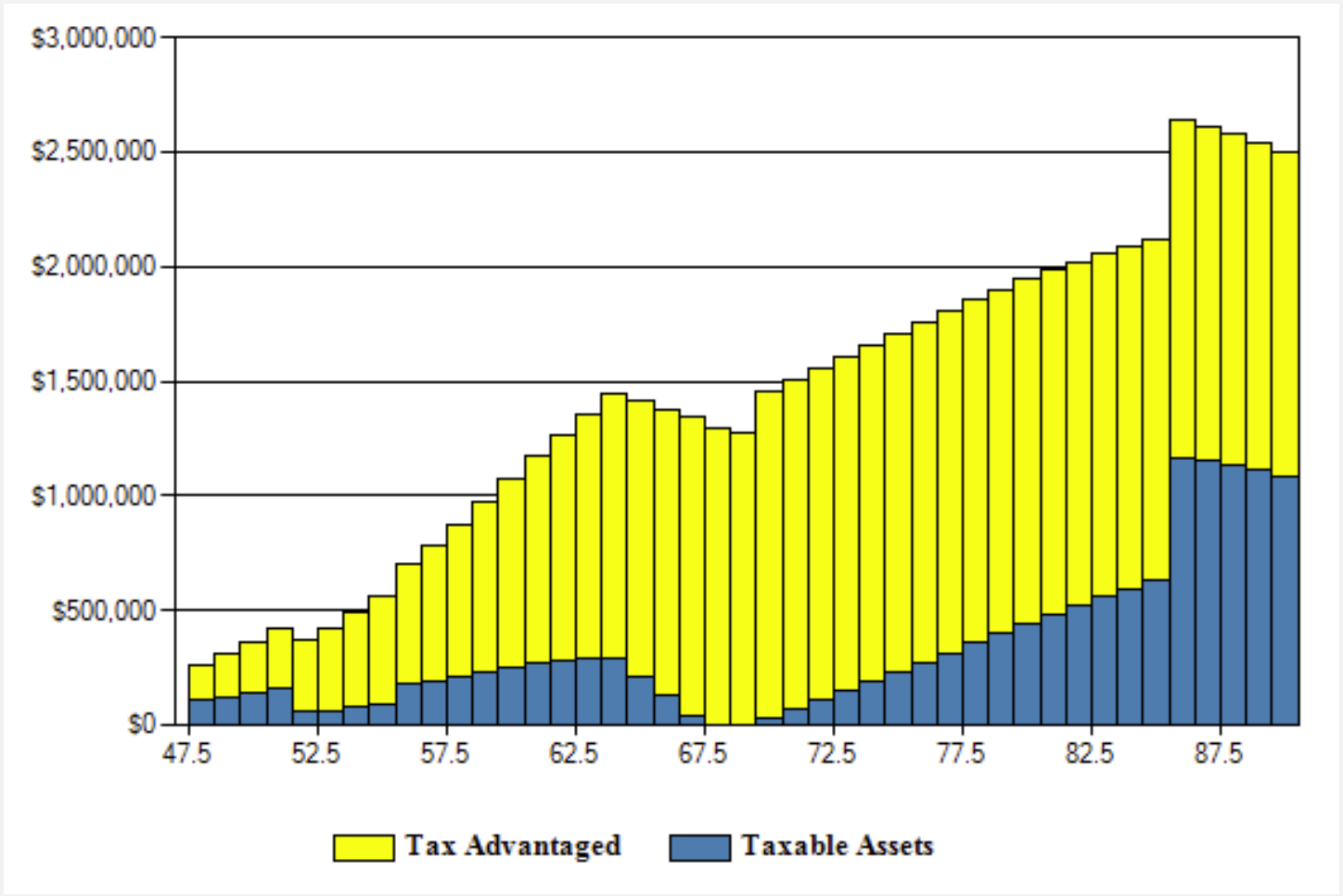
After tax rates of return average 6.12%, with a std. dev. of 8% (95% of values fall between -9.18% and 22.82%).

Monte Carlo Mathematical Model

- These balances and flows may be projected over time and combined into a cohesive model, an approximation of a complex financial life.
- Assets, Income, Additions, Growth
- Expenses, Withdrawals, Taxes
- Pensions, Social Security, Insurance
- Plans, Provisions, Special Situations

Retirement Expense Projection

Retirement Asset Projection



Variables within the Model

The real world is unpredictable, and things do change:

- Year by Year Asset Growth
- Rate of Return on Deposits
- Year by Year Inflation Effects

Why Use Monte Carlo?

- Illustrate variability & uncertainty
- Test models in a variable environment
- Help design portfolios with less variability
- Show the need for ongoing monitoring
- Convey a confidence level to the client
- Demonstrate unequivocally that the client's financial future is unknown and changeable

Change, Fluctuations & Chaos

- Random Behavior in Natural Systems
  - tree growth, weather, populations
- Noise vs. Trends
  - variations from the norm are normal
- Chaos is
  - great complexity, multiple interactive influences, questionable predictability

Chaos

- Patterns indiscernible at one level are often clear at higher levels
- Interactions and relationships are complex and subtle
- Individual outcomes are unknowable, yet the larger trends and cumulative results may be predictable

Simulation Technology

- Simulation technology uses simulated chaos to find larger trends and cumulative results of complex systems
- Statistical analysis of results can help relate trends to simpler percentage terms
- Graphic representations may help illustrate both the technique and the resulting trends and scope of calculations

Why Use Simulation Technology?

- Illustrates & Communicates Uncertainty
  - Full Disclosure / Compliance Issues
- Promote Scheduled Plan Re-evaluation
  - Annual or Bi-annual Plan Reviews
- Return/Inflation Sensitivity Measurement
  - Plan performance evaluation

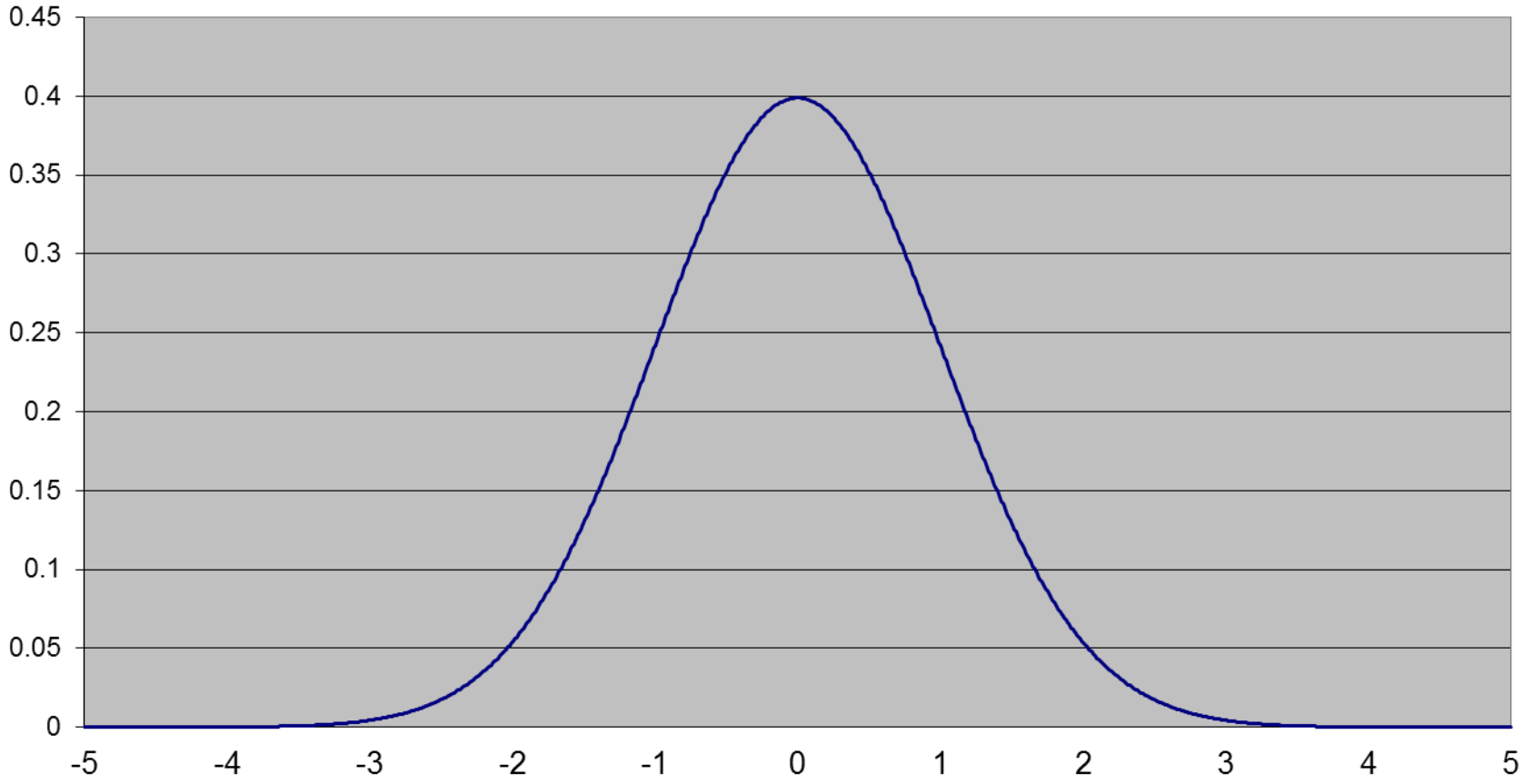
How to Present the Simulation

- State assumptions about the general financial plan, and discuss the results of the average or nominal projections calculated statically
- Explain the effects of market and economic environment on the plan's assumptions
- Show the Simulation results as a representation of a potential range of actual results based on changing and unpredictable markets
- Discuss comfort level and probable outcomes

Standard Normal Density Function

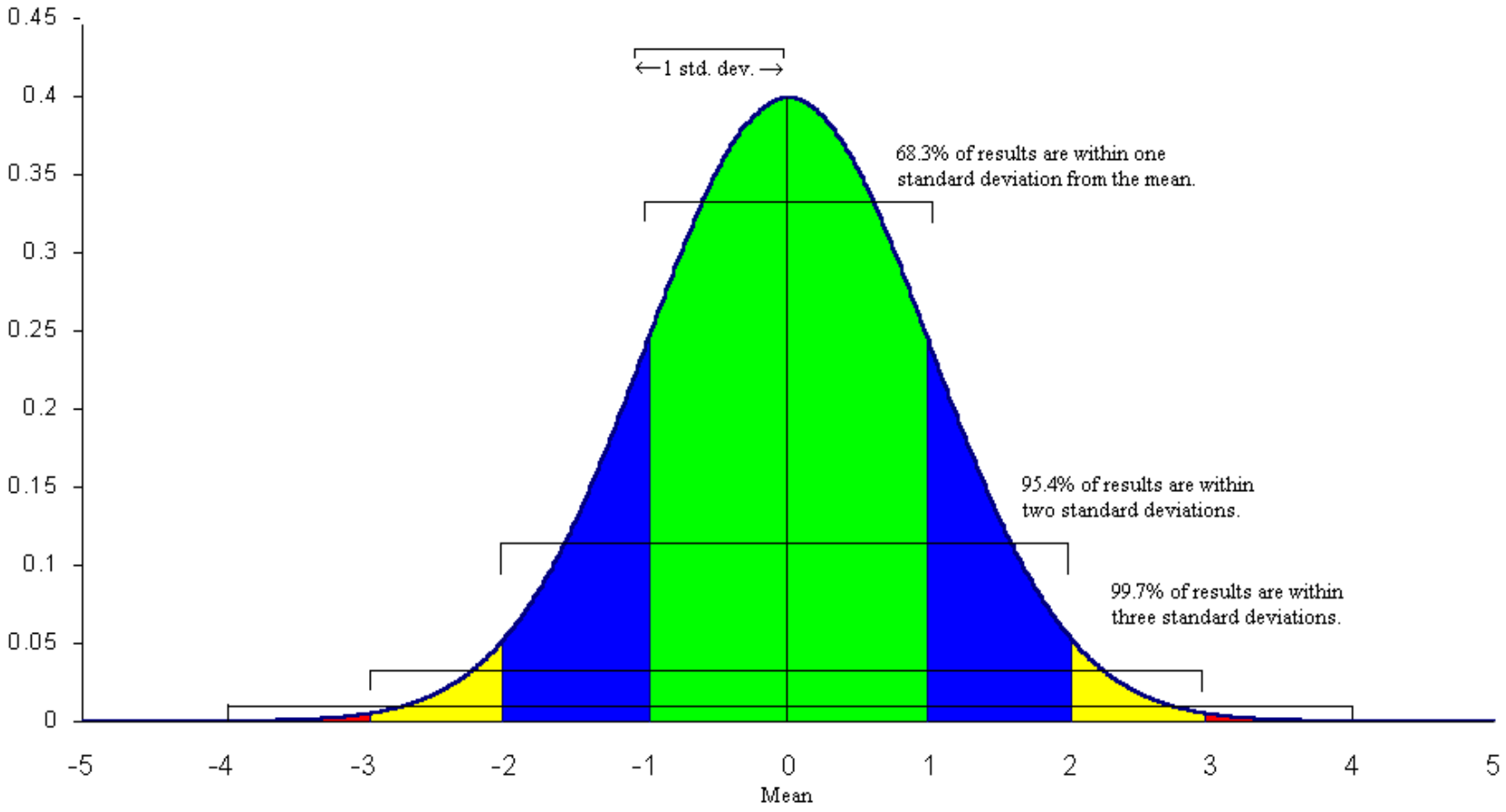
Graph of the Standard Normal Density Function

$$g(x) = \frac{1}{\sqrt{2\pi}} e^{-x^2/2}$$

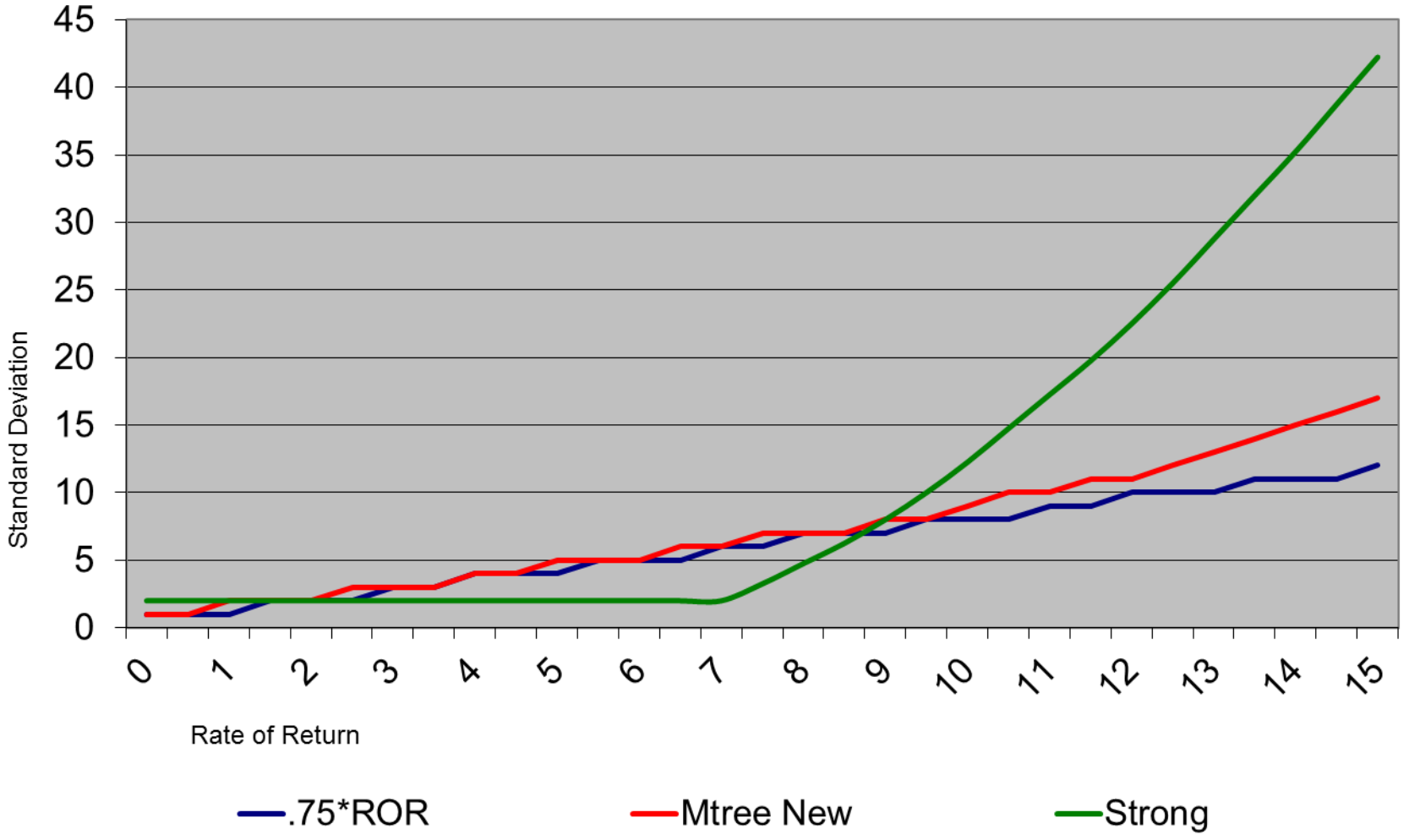


Normal Distribution & Standard Deviation

Standard Deviation is a way to describe variance in a set of numbers. Monte Carlo Simulation uses normally distributed random numbers to create model trials. The standard deviation chosen for the simulation determines the range of possible and most probable results for each period. This illustration of normally distributed numbers shows how results are dispersed.



Standard Deviation Functions



Portfolio Standard Deviation Calculations

This is an example of a technique used to calculate the standard deviation of a mixed portfolio of 30% Bonds, 40% MidCap fund and 30% SmallCap fund.

	Bonds	MidCap	SmallCap
Portfolio:	30%	40%	30%
Rates of Return:	4.5%	13.0%	18.6%
Standard Dev :	3.0%	11.0%	20.0%

Portfolio Standard Deviation Calculation:

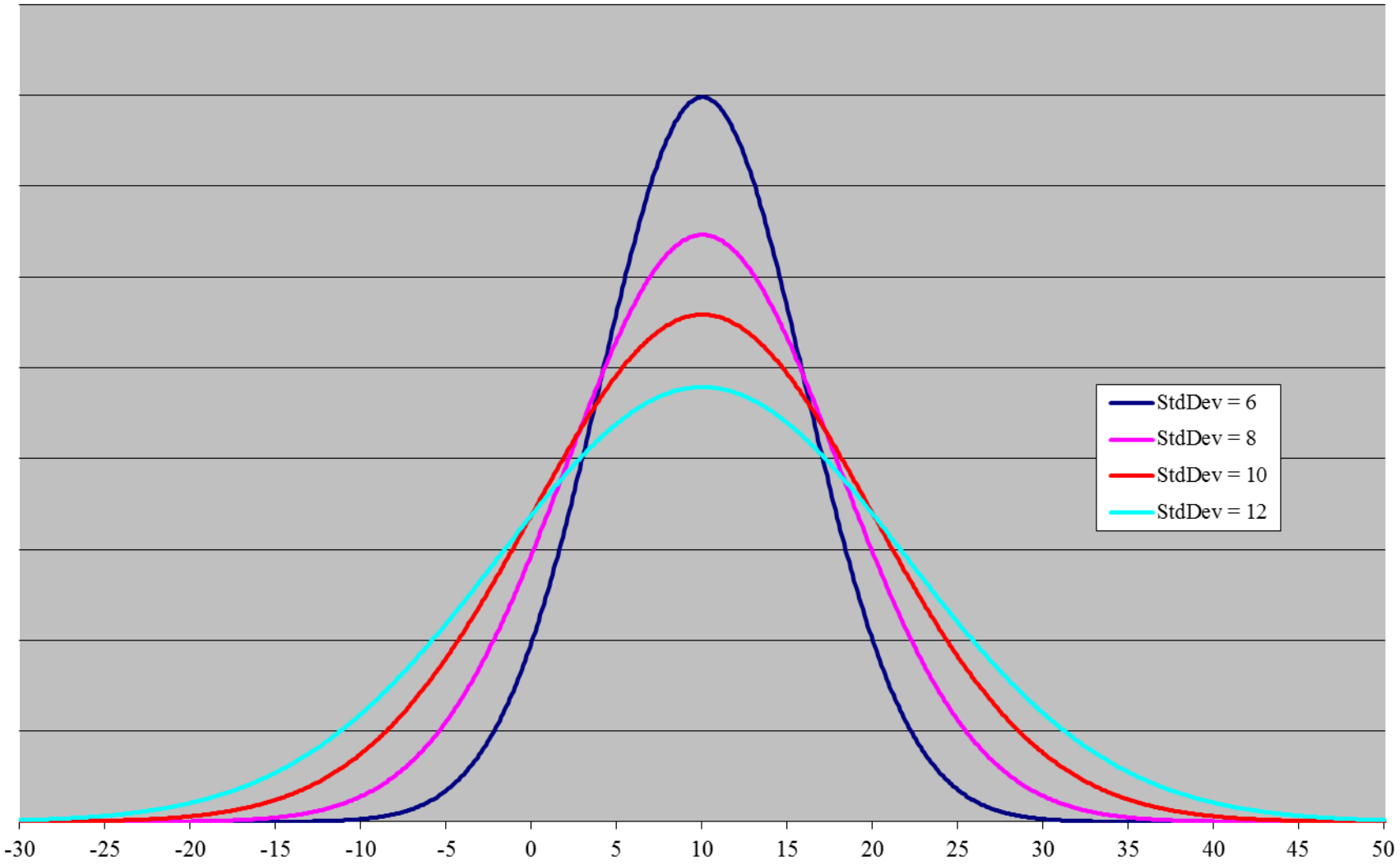
Rate of Return = (.30)(4.5%) + (.40)(13%) + (.30)(18.6%) = 12.13%

Variance = $(.30)^2 * (3)^2 + (.40)^2 * (13)^2 + (.30)^2 * (20)^2$

Variance = (.09) * (9) + (.16) * (169) + (.09) * (400) = 63.85%

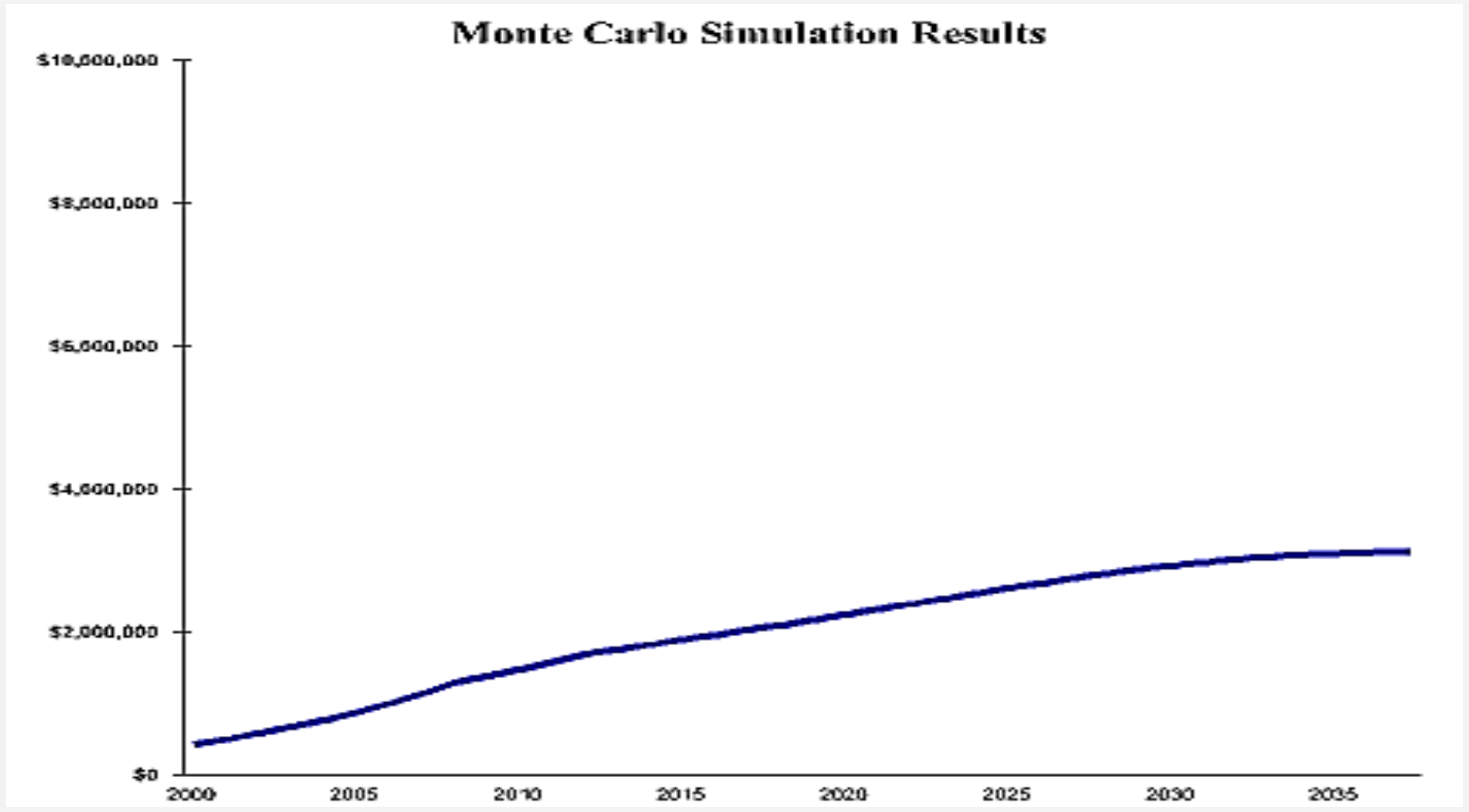
Standard Deviation = Square Root (63.85%) **= 7.99%**

Effects of Standard Deviations



Standard Deviation: Zero

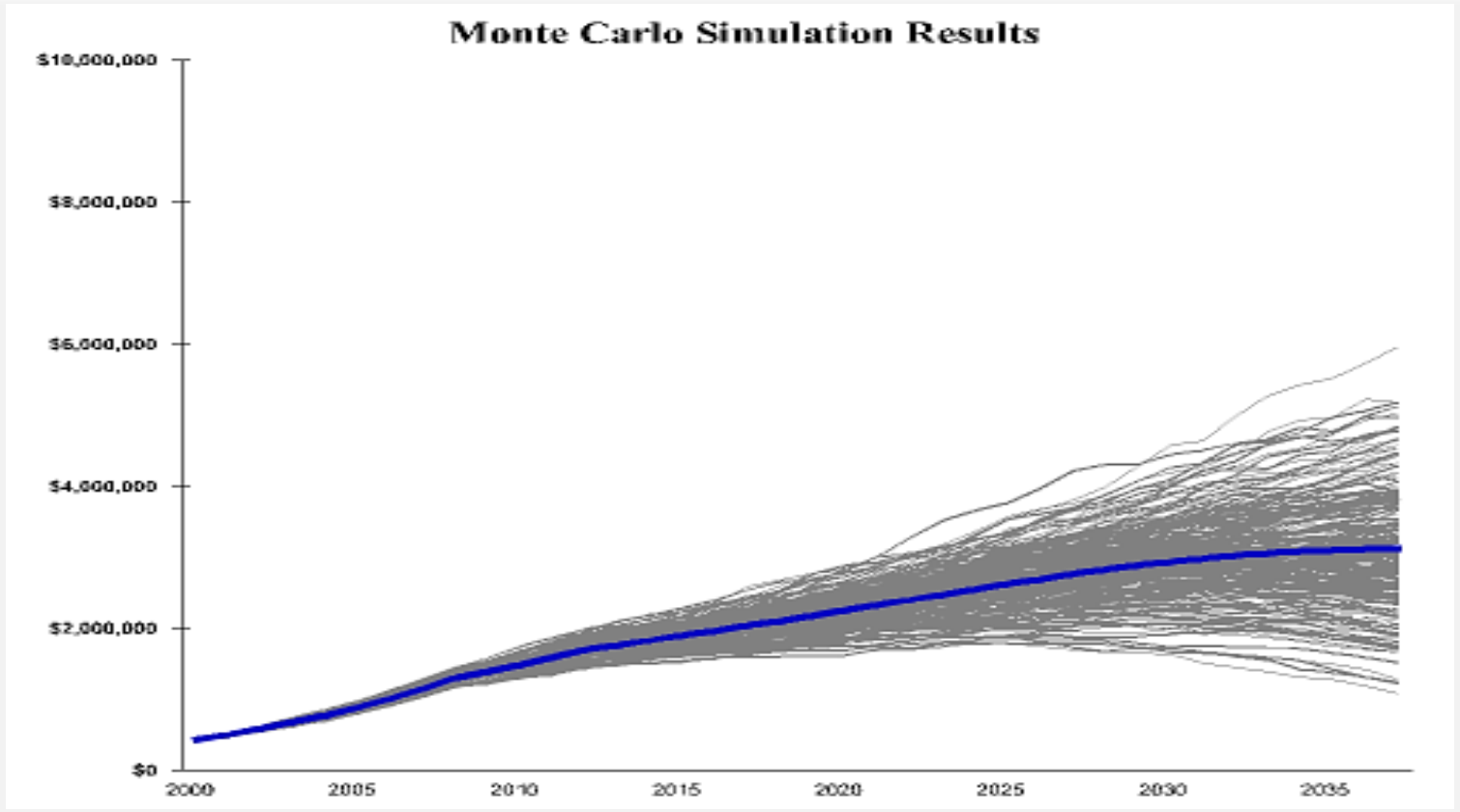
Results of 1000 Simulations:		Minimum Monte Carlo projection	$3,123,022
Percentage of projections above zero	100%	Average Monte Carlo projection	$3,123,022
Retirement Projection Estimate	$3,123,022	Maximum Monte Carlo projection	$3,123,022



After tax rates of return average 6.82%, with a std. dev. of 0% (95% of values fall between 6.82% and 6.82%).

Standard Deviation: Two

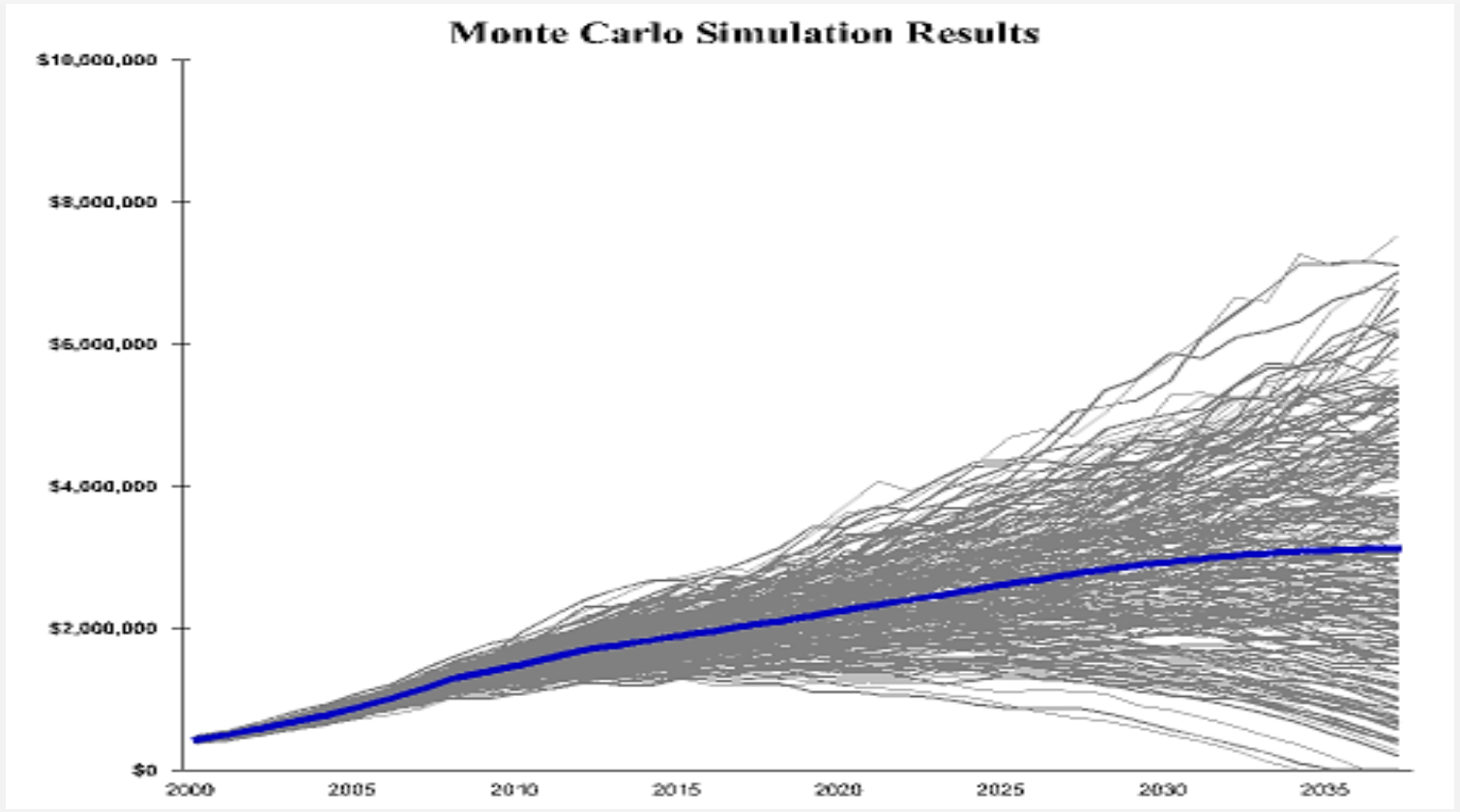
Results of 1000 Simulations:			
Percentage of projections above zero	100%	Minimum Monte Carlo projection	$653,639
Retirement Projection Estimate	$3,123,022	Average Monte Carlo projection	$3,129,001
		Maximum Monte Carlo projection	$6,303,086



After tax rates of return average 6.82%, with a std. dev. of 2% (95% of values fall between 2.82% and 10.82%).

Standard Deviation: Four

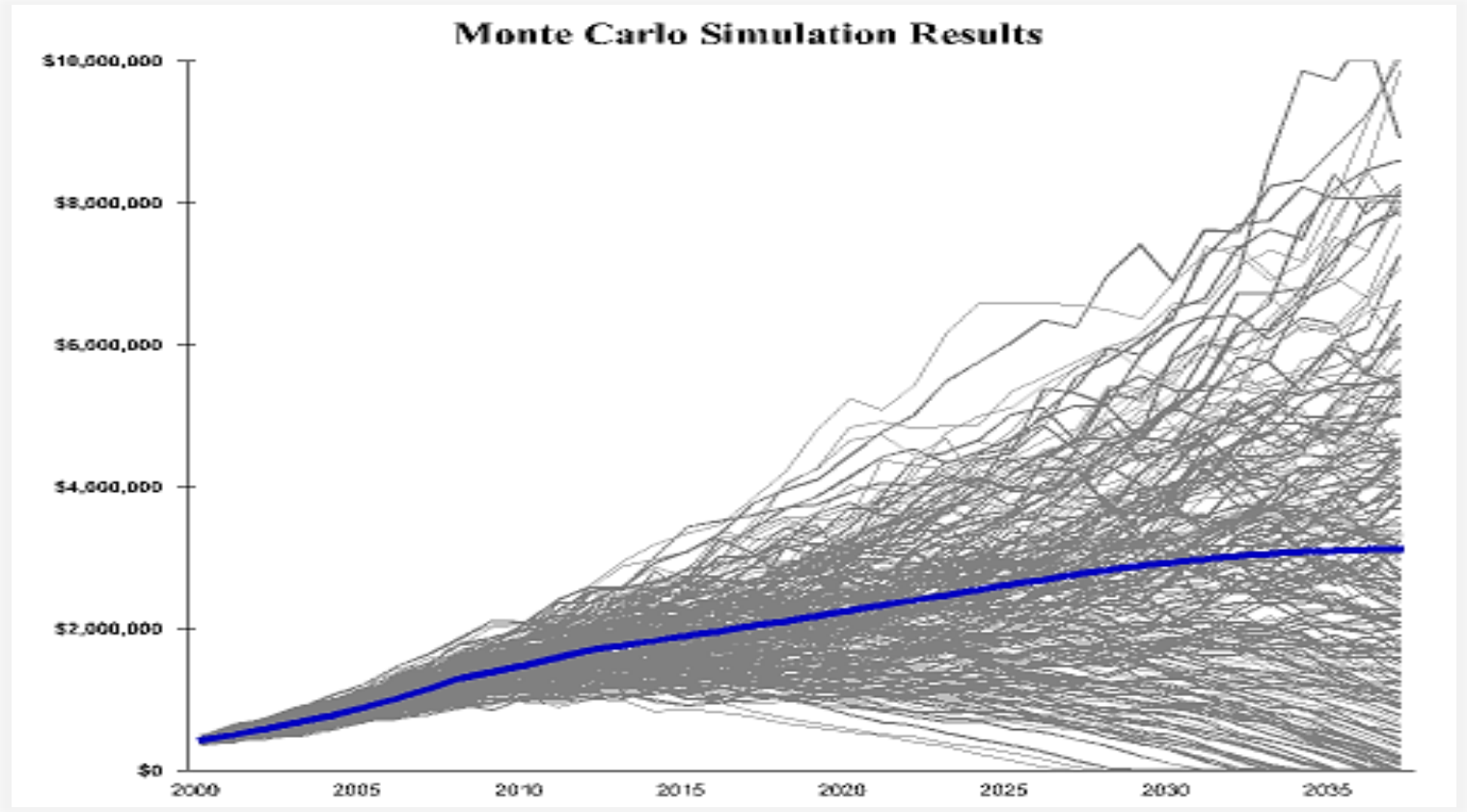
Results of 1000 Simulations:		Minimum Monte Carlo projection	$0
Percentage of projections above zero	99%	Average Monte Carlo projection	$3,151,228
Retirement Projection Estimate	$3,123,022	Maximum Monte Carlo projection	$10,119,274



After tax rates of return average 6.82%, with a std. dev. of 4% (95% of values fall between -1.18% and 14.82%).

Standard Deviation: Seven

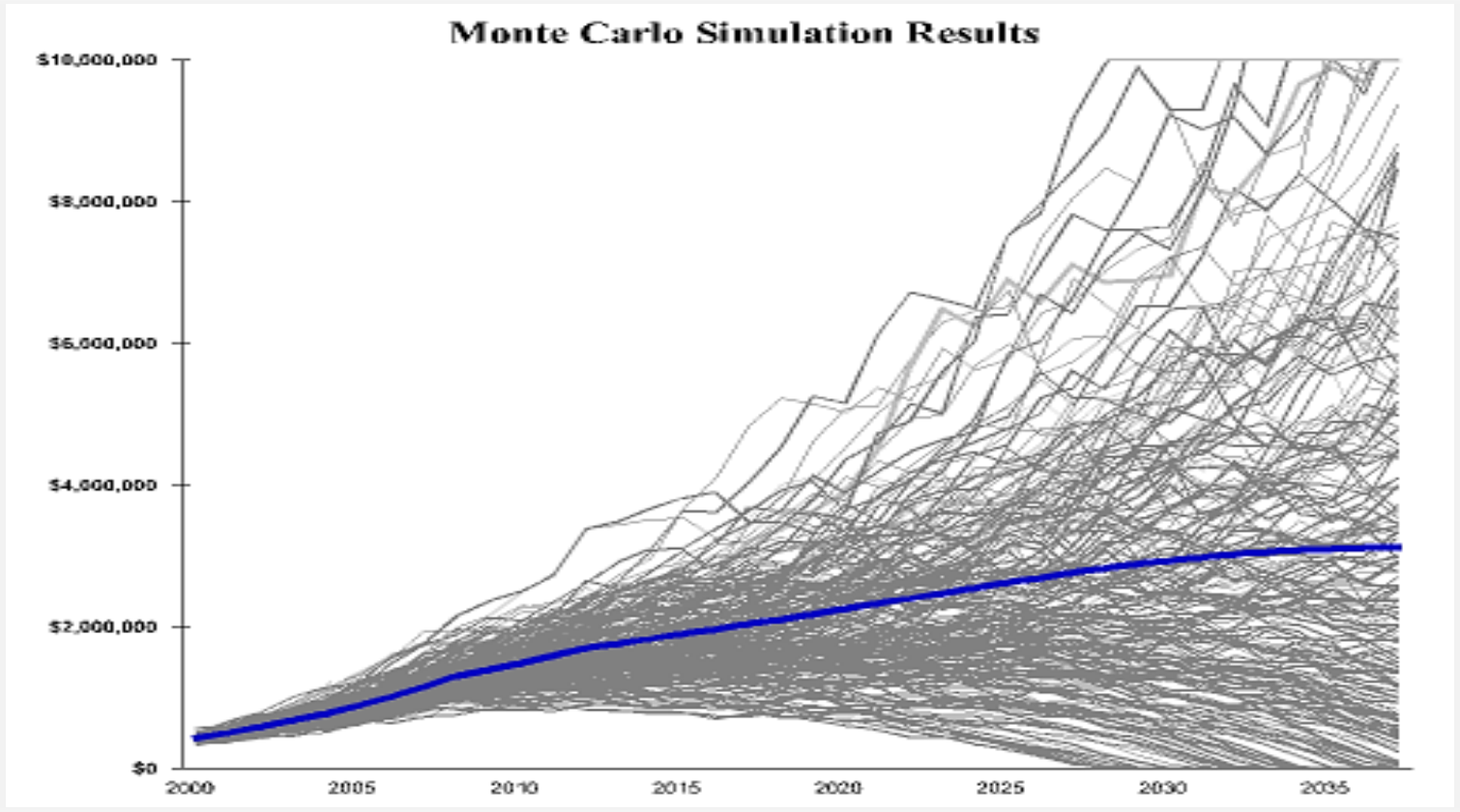
Results of 1000 Simulations:			
Percentage of projections above zero	86%	Minimum Monte Carlo projection	$0
Retirement Projection Estimate	$3,123,022	Average Monte Carlo projection	$3,030,590
		Maximum Monte Carlo projection	$19,653,719



After tax rates of return average 6.82%, with a std. dev. of 7% (95% of values fall between -7.18% and 20.82%).

Standard Deviation: Eight

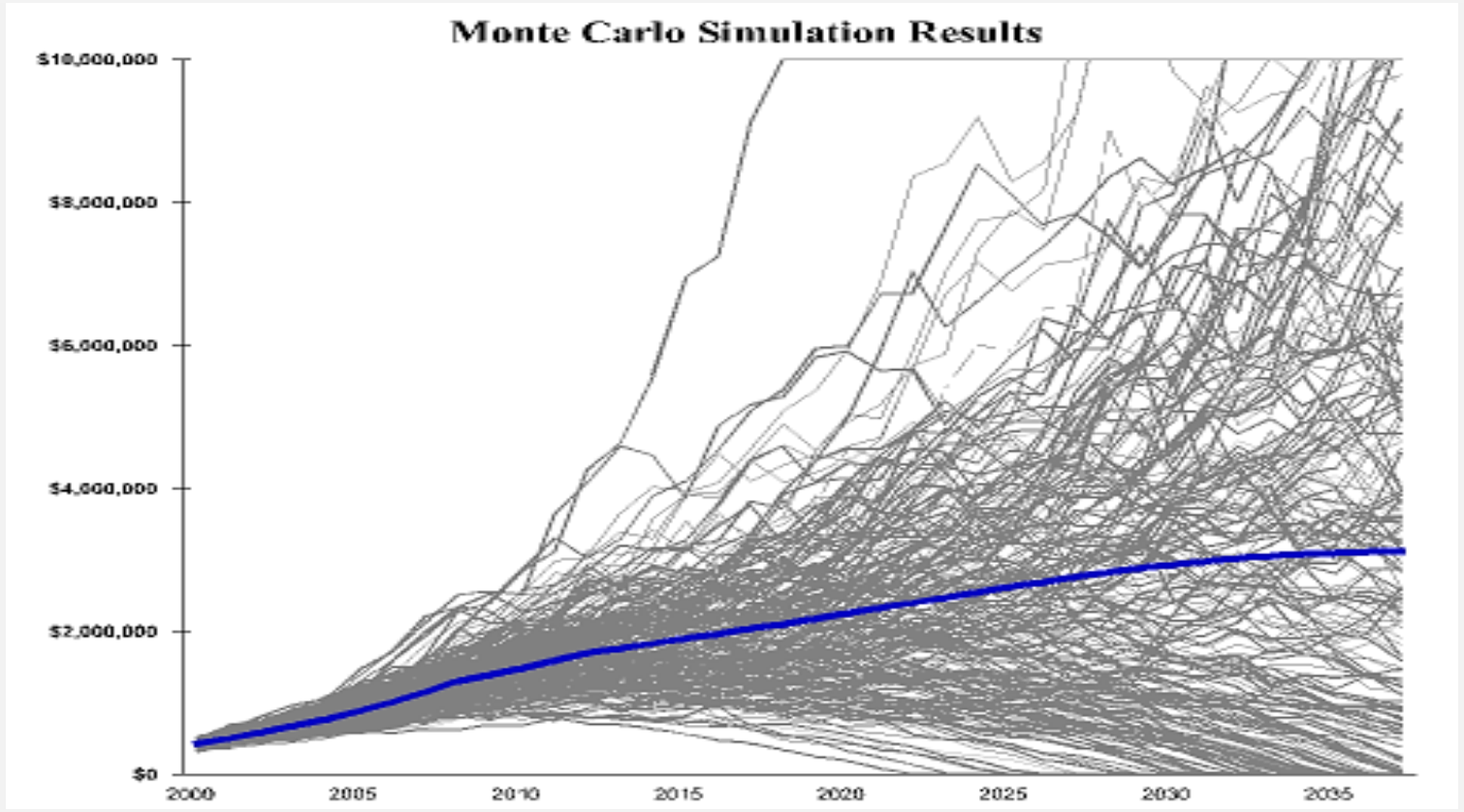
Results of 1000 Simulations:			
Percentage of projections above zero	84%	Minimum Monte Carlo projection	$0
Retirement Projection Estimate	$3,123,022	Average Monte Carlo projection	$3,165,938
		Maximum Monte Carlo projection	$20,351,776



After tax rates of return average 6.82%, with a std. dev. of 8% (95% of values fall between -9.18% and 22.82%).

Standard Deviation: Ten

Results of 1000 Simulations:			
Percentage of projections above zero	75%	Minimum Monte Carlo projection	$0
Retirement Projection Estimate	$3,123,022	Average Monte Carlo projection	$3,368,356
		Maximum Monte Carlo projection	$35,466,671



After tax rates of return average 6.82%, with a std. dev. of 8% (95% of values fall between -9.18% and 22.82%).

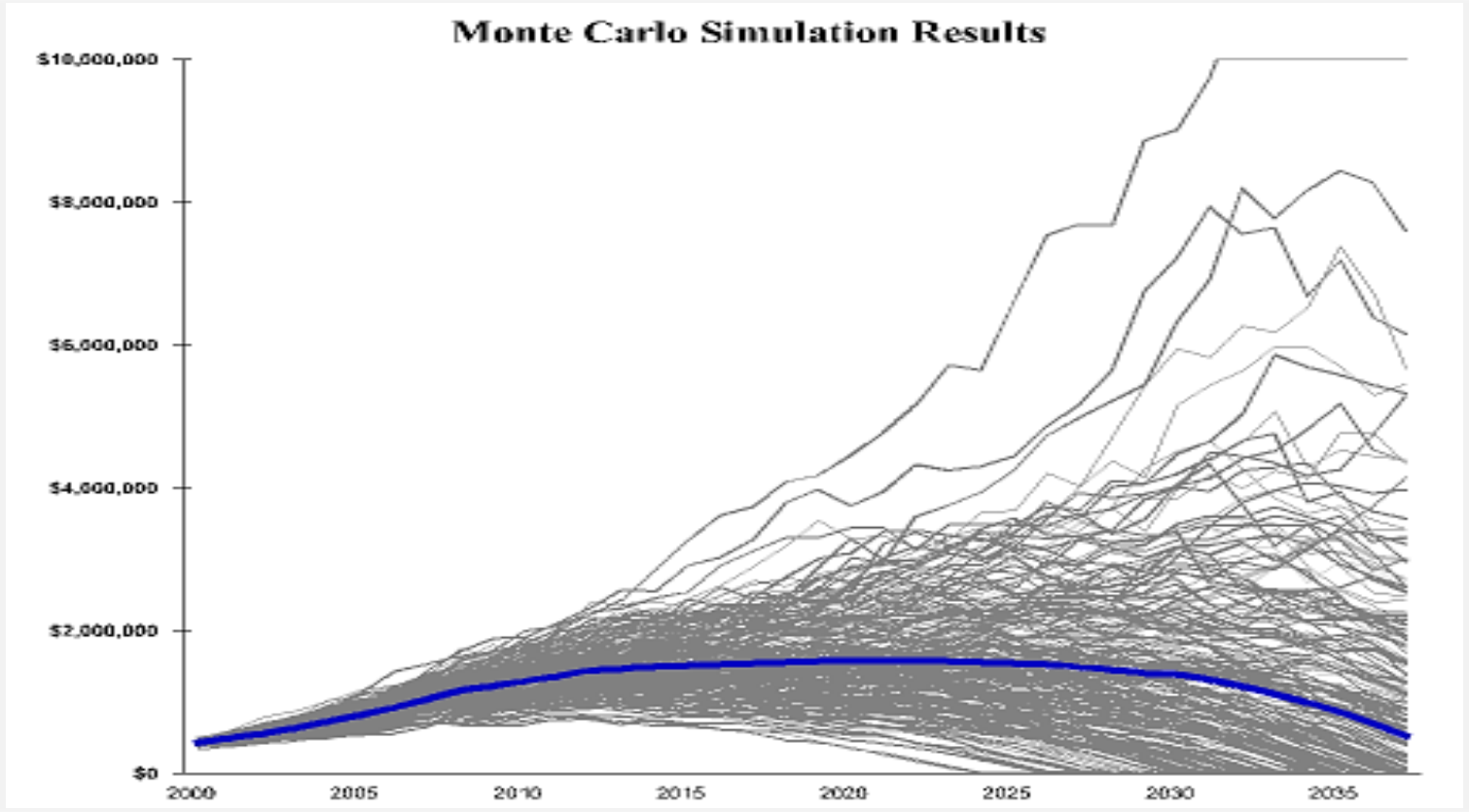
Plan Analysis:

Evaluating Projections During Uncertain Conditions

- Measure plan results, and evaluate the probability of plan success through life expectancy
- Modify the plan to adjust for uncertainty and provide a comfortable level of plan performance
- Consider effects of portfolio allocation on risk and uncertainty
- Review plan performance over time

Analysis: Starting Projection

Results of 1000 Simulations:			
Percentage of projections above zero	59%	Minimum Monte Carlo projection	$0
Retirement Projection Estimate	$526,036	Average Monte Carlo projection	$932,570
		Maximum Monte Carlo projection	$14,143,859

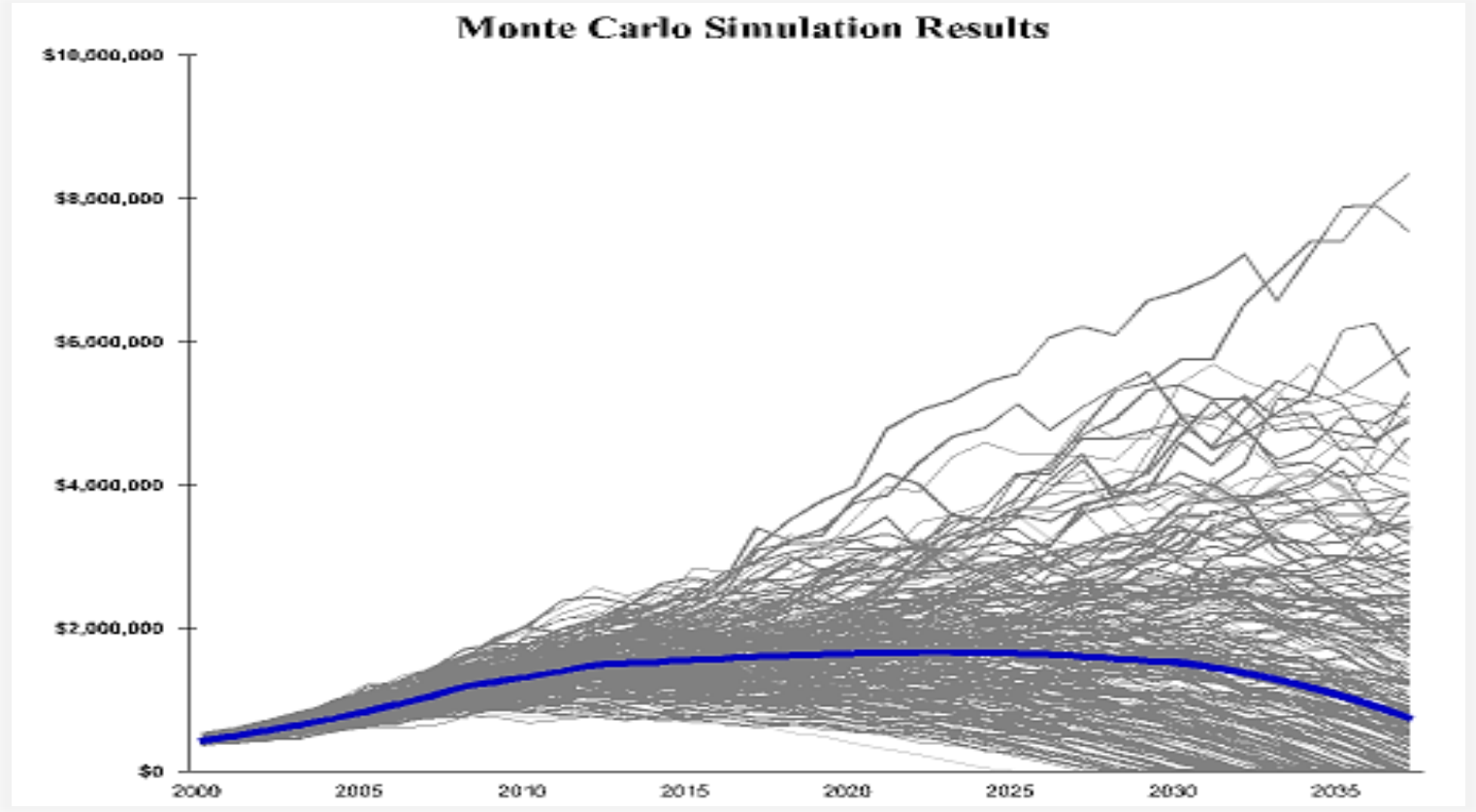


After tax rates of return average 6.12%, with a std. dev. of 7% (95% of values fall between -7.88% and 20.12%).

Analysis: Starting Projection + $3000

Results of 1000 Simulations:	
Percentage of projections above zero	60%
Retirement Projection Estimate	$751,836

Minimum Monte Carlo projection	$0
Average Monte Carlo projection	$1,112,433$
Maximum Monte Carlo projection	$10,275,389

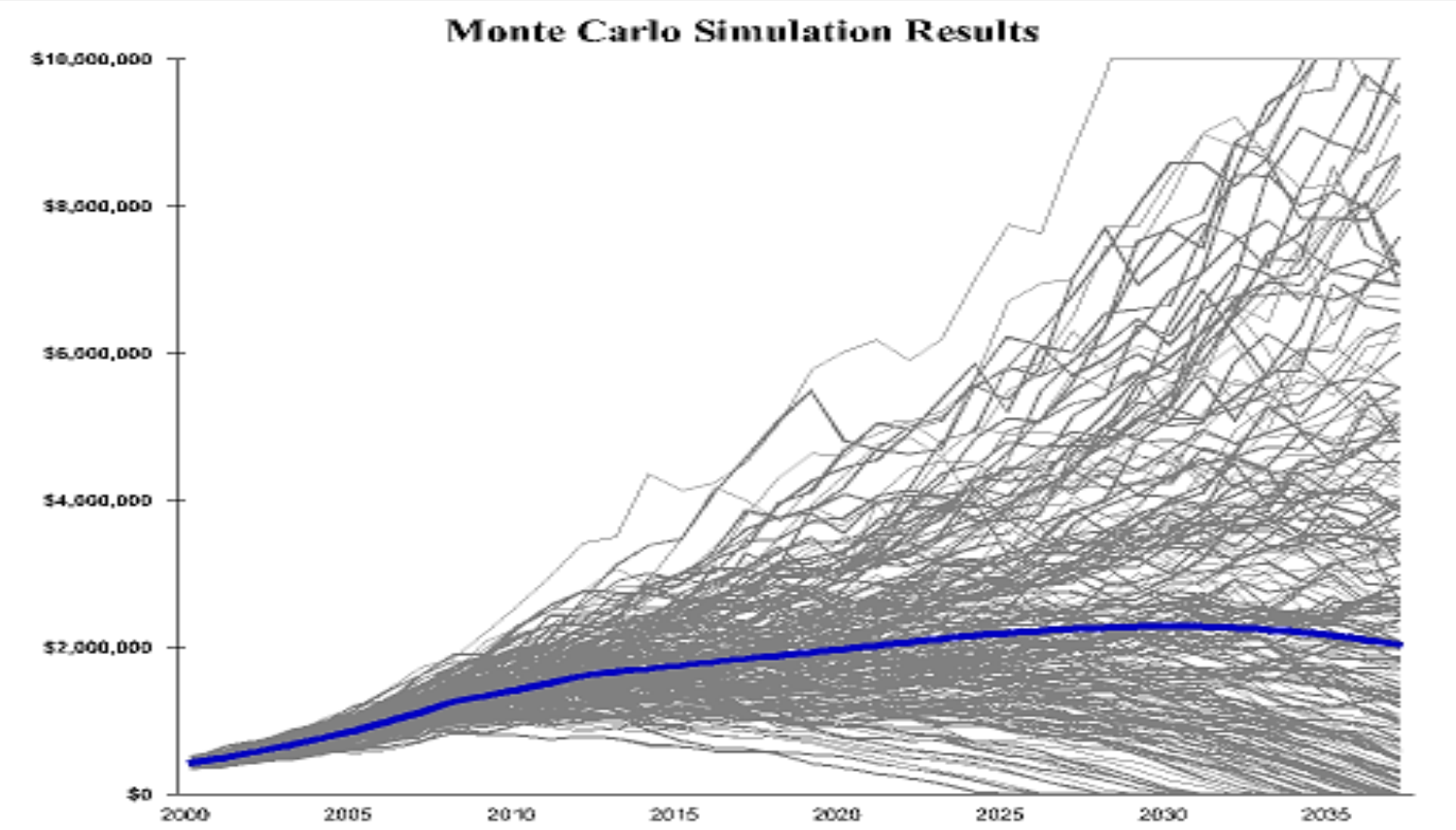


After tax rates of return average 6.12%, with a std. dev. of 7% (95% of values fall between -7.88% and 20.12%).

Analysis: Starting Projection + $6000

Results of 1000 Simulations:	
Percentage of projections above zero	80%
Retirement Projection Estimate	$2,037,342

Minimum Monte Carlo projection	$0
Average Monte Carlo projection	$2,403,443
Maximum Monte Carlo projection	$22,440,606



After tax rates of return average 6.12%, with a std. dev. of 7% (95% of values fall between -7.88% and 20.12%).

Monte Carlo

Thank you for taking the time to review the introduction to Monte Carlo.

Questions?

Ask Money Tree's Support Team

Toll free 1.877.421.9815
support@moneytree.com