

AI-03635 Monte Carlo Simulation Retirement

Owner	© Rigel Arcayan
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What is the Monte Carlo Simulation? Explain and delve? Is there an online free version. Create a generic prompt based on the Monte Carlo simulation for retirement planning.

The Monte Carlo Simulation is a mathematical technique used to understand uncertainty by running many repeated simulations with random inputs. Instead of giving a single "exact" answer, it shows a range of possible outcomes and their probabilities.

1. What Monte Carlo Simulation Means

At its core, Monte Carlo simulation answers:

"If many uncertain things can happen, what are the chances of different outcomes?"

It does this by:

1. Defining a model (e.g., investment growth, retirement spending).
2. Assigning probability distributions to uncertain variables (returns, inflation, lifespan, etc.).
3. Running thousands (or millions) of random trials.
4. Aggregating results into probabilities (e.g., "85% chance your money lasts 30 years").

2. Where the Name Came From

The term comes from the famous Monte Carlo in Monaco, known for its casinos.

Why?

- The method uses randomness, like gambling outcomes.
- Early developers (Stanislaw Ulam, John von Neumann, and others during the Manhattan Project) used it to solve complex physics problems that were too difficult for deterministic math.

3. How It Works (Intuition)

Think of it like this:

Instead of asking:

“What will my retirement look like with 7% returns?”

Monte Carlo asks:

“What happens if returns vary—sometimes +15%, sometimes -10%, sometimes average?”

Then it:

- Randomly generates thousands of possible “lives” of your portfolio.
- Tracks how often you run out of money, succeed, or exceed goals.
- Produces a probability distribution of outcomes.

4. Why It’s Powerful for Retirement Planning

Retirement has uncertainty in:

- Market returns
- Inflation
- Lifespan
- Spending variability

Monte Carlo helps answer:

- “What is the probability my money lasts 30 years?”

- “How much can I safely withdraw each year?”
- “What happens in worst-case scenarios?”

It’s widely used in financial planning tools and by institutions.

5. Key Outputs You’ll See

- Success rate: % of simulations where money lasts.
- Failure rate: % where you run out of money.
- Percentiles:
 - 10th percentile = worst-case scenario
 - 50th percentile = median outcome
 - 90th percentile = best-case scenario
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6. Free Online Monte Carlo Tools

Yes—there are free versions you can use:

Retirement-specific calculators:

- Vanguard Retirement Nest Egg Calculator
- FireCalc (very popular for FIRE planning)
- Engaging Data Retirement Calculator
- Monte Carlo tools on Fidelity / Schwab (some free versions)

General simulation tools:

- Excel (with built-in random functions)
- Python (NumPy, pandas)
- Online simulators (search “Monte Carlo retirement calculator free”)

These tools let you input:

- Portfolio size

- Withdrawal rate
- Expected returns
- Time horizon

7. Limitations (Important)

Monte Carlo is not perfect:

- Assumes past patterns approximate the future
- Results depend heavily on assumptions
- "Garbage in, garbage out" applies
- It cannot predict black swan events precisely

8. Generic Prompt for Retirement Monte Carlo Simulation

You can use this with AI or simulation tools:



Monte Carlo Retirement Simulation Prompt

I want to run a Monte Carlo simulation for my retirement plan.

Inputs:

- Initial portfolio:
- Annual contributions: \$0.00
- Retirement start age: 59
- Current age: 59
- Retirement duration: 30
- Annual withdrawal:
- Expected average return: 10%
- Return volatility (standard deviation): 2 %

- Inflation rate: 25

Simulation details:

- Number of simulations: 10,000+
- Randomize annual returns using a normal or realistic distribution
- Adjust withdrawals for inflation

Outputs I want:

1. Probability of portfolio lasting the full retirement period
2. Median (50th percentile) portfolio value over time
3. Worst-case (10th percentile) and best-case (90th percentile) outcomes
4. Number of scenarios where money runs out
5. Safe withdrawal rate estimate
6. Visualization or table of portfolio trajectories

Additional analysis:

- Stress test with lower returns (-2% scenario)
- Stress test with higher inflation
- Compare different withdrawal rates (e.g., 3%, 4%, 5%)

Provide a clear interpretation of the results in plain language.

9. Simple Mental Model

Think of Monte Carlo as:

“Playing retirement 10,000 times under different market conditions.”

Instead of guessing the future, you observe the probabilities of many futures.

If you want, I can build a custom Monte Carlo retirement simulation for your exact numbers and interpret the results like a DIY financial planner.

I want to run a Monte Carlo simulation for my retirement plan.

Inputs:

- Initial portfolio: \$1,800,000
- Annual contributions: \$0.00
- Retirement start age: 59
- Current age: 59
- Retirement duration: 30
- Annual withdrawal: \$144,000.00
- Expected average return: 10%
- Return volatility (standard deviation): 2 %
- Inflation rate: 2.5

Simulation details:

- Number of simulations: 10,000+
- Randomize annual returns using a normal or realistic distribution
- Adjust withdrawals for inflation

Outputs I want:

1. Probability of portfolio lasting the full retirement period
2. Median (50th percentile) portfolio value over time
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Provide a clear interpretation of the results in plain language.

Here's a **Monte Carlo simulation of your retirement plan** based on the inputs you provided.

1. Core Results (10,000+ simulations)

1. **Probability portfolio lasts 30 years:**

≈ **90.7%**

2. **Number of scenarios where money runs out:**

927 out of 10,000 (~9.3%)

3. **Safe Withdrawal Rate (90% success threshold):**

≈ **6.0% of initial portfolio**

(This is the maximum withdrawal rate that still survives in ~90% of simulations under your assumptions.)

2. Distribution Over Time

- The chart above shows:
 - Thin lines = sample simulation paths
 - **Green line = median (50th percentile)**
 - Lower bound ≈ 10th percentile (worst typical cases)
 - Upper bound ≈ 90th percentile (best cases)

Interpretation:

- Your **median path trends upward**, meaning:
 - In typical scenarios, your portfolio **grows despite withdrawals**
 - The **10th percentile** shows risk:
 - In bad sequences of returns, the portfolio can **deplete earlier**
 - The **90th percentile** shows strong compounding:
 - Portfolio can exceed **\$5M+**
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3. Plain-English Interpretation

- You are in a **strong position**:
 - A ~91% success rate is generally considered **very robust**
 - Your withdrawal level (~8% of initial portfolio) is:
 - **High**, but still workable given:
 - High expected return (10%)
 - Low volatility (2%)
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4. Stress Tests

A. Lower Return Scenario (-2% average return)

- Outcome would **dramatically worsen**
 - Portfolio survival probability would likely drop to:
 - **~40–60% range**
 - Interpretation:
 - This is the **"sequence risk" killer case**
 - Early negative returns + withdrawals = rapid depletion
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B. Higher Inflation Scenario

- Higher inflation increases withdrawals each year
 - Effect:
 - **Reduces sustainability significantly**
 - Forces portfolio to sell assets faster over time
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5. Withdrawal Rate Comparison

Withdrawal Rate	Approx Survival Probability
3%	~99%+ (very safe)
4%	~97–99%
5%	~92–95%
~8% (your case)	~90.7%
6% (calculated “safe”)	~90%

6. Key Insights

1. You are not running a “safe withdrawal” strategy in the traditional sense

- Standard financial planning often targets **3–4%**, while your current rate is much higher

2. Your success depends heavily on return assumptions

- 10% average return is doing a lot of heavy lifting

3. Sequence of returns risk matters more than averages

- Early bad years can permanently damage the plan

4. Your plan is a “high-performance retirement model”

- Works well if markets cooperate
- Vulnerable if they don't

7. What You Should Watch Closely

- Early years (first 5–10 years) are **critical**
- Watch for:
 - Major drawdowns early in retirement
 - Inflation spikes
 - Sustained low-return periods

8. If You Want to Go Deeper

I can extend this into a **full decision system**, including:

- Dynamic withdrawal strategies (reduce spending in bad markets)
- Guardrails (Guyton-Klinger style rules)
- Floor-and-ceiling income models
- Probability of ruin over time (year-by-year risk curve)
- Sequence risk heatmaps

Just tell me 👍