CallCulator Handbook

Basic version

Aaron Gonsior

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1 Welcome to CallCulator

CallCulator is a web-based tool for analyzing options trading strategies. It helps you find smarter investments by going beyond simple "gut feelings" and instead using real market data combined with your own outlook on a stock or financial asset generally.

The platform offers three main features (called **modes**):

1. **Basic Calculation** – Enter a custom option strategy and see how it performs.
2. **Probability & Risk** – Let CallCulator *find* the best strategy for you based on your beliefs and risk tolerance.
3. **Max Min** – Find strategies with the best worst-case scenarios.

You can switch between these modes using the tabs at the top of the page.

2 What Are Options?

2.1 The Concept

An **option** is a financial contract—think of it as a piece of paper—that gives its owner a specific *right* related to a stock/asset. There are two basic types:

- **Call Option:** The right to *buy* a stock at a fixed price by a fixed date.
- **Put Option:** The right to *sell* a stock at a fixed price by a fixed date.

The fixed price is called the **strike price** and the fixed date is called the **expiration date**. Crucially, it is a *right*, not an obligation—you can choose not to use it.

2.2 A Concrete Example: Call Option

Imagine you hold a piece of paper that says:

> *"The owner of this paper has the right to buy one share of Tesla stock ($TSLA) for $500 on December 31, 2028."*

This paper is a **call option** with a strike price of $500 and an expiration date of December 31, 2028.

This paper has a value that is determined by the open market (supply and demand), and it depends mainly on:

- **Stock Price:** The primary driver. If the stock price is far below $500, the right to buy at $500 is nearly worthless. As it climbs closer to or above $500, the value increases significantly.
- **Time to Expiration:** Options are wasting assets. More time means more opportunity for the stock to make a favorable move, commanding a higher premium. As expiration approaches, this "time value" decays.
- **Volatility:** High volatility means the stock swings wildly, increasing the probability of extreme price outcomes (like reaching $500). Therefore, higher volatility increases the option's value.

You can buy or sell this paper on the stock market at any time before expiration, just like a stock.

At the expiration date, the paper is worth its **intrinsic value**—the actual profit you would make by exercising the right:

- If Tesla is at **$600**: The right to buy at $500 is worth **$100** (you buy at $500, sell at $600, pocket $100).
- If Tesla is at **$550**: The right to buy at $500 is worth **$50**.
- If Tesla is at **$500 or below**: The right is worthless—why buy at $500 when you can buy cheaper on the open market? The paper expires with a value of **$0**.

The price you pay to acquire this paper is called the **premium**. If you paid $30 for the paper and Tesla ends up at $600, your profit is $100 − $30 = $70, which is a $70/$30 ≈ +233% return. Having bought the Tesla share itself would have resulted in a profit of $\frac{\$600-\$500}{\$500} = +20\%$ thus the option has greatly amplified the profit. If Tesla stays below $500, you lose the $30 you paid—a −100% return on that investment. This is the **leverage** effect: small price movements in the stock translate to large percentage swings in the option.

2.3 Put Options

A put option works in reverse: it gives you the right to *sell* a stock at the strike price. You profit when the stock goes *down*. If you hold a put with a $500 strike and the stock drops to $400, the put is worth $100 (you sell at $500 something the market values at $400).

2.4 American vs. European Options

While you can trade (buy/sell) any option on the market at any time, there is a distinction in when you can **exercise** the right to buy or sell the underlying stock:

- **American-Style:** You can exercise the option at any point up to and including the expiration date. Most standard equity options are American-style.
- **European-Style:** You can only exercise the option on the expiration date itself. Index options are often European-style.

For most traders, this distinction is technical because options are rarely exercised early; they are usually sold to close the position.

2.5 Shorting: Selling What You Don't Own

You may have heard the phrase "shorting a stock." But how can you sell something you don't own? The mechanism works like this:

1. You **borrow** a stock from someone who owns it, with the promise to give it back later.
2. You immediately **sell** the borrowed stock on the open market and keep the cash.
3. Later, you **buy the stock back** on the open market (hopefully at a lower price) and return it to the lender.

If the stock price dropped between step 2 and step 3, you pocket the difference as profit. If it rose, you lose money because you have to buy it back at a higher price.

Example: You borrow one share of Tesla at $500 and sell it immediately, pocketing $500. A month later, Tesla has dropped to $400. You buy one share for $400, return it to the lender, and keep $500 − $400 = $100 profit. But if Tesla rose to $600, you would have to buy back at $600 and lose $600 − $500 = $100.

Shorting carries potentially unlimited risk—the price can rise without limit—which is why it is used carefully.

Shorting options works the same way. On CallCulator, you can also short (sell/write) call and put options. Instead of borrowing a stock, you borrow an option contract, sell it, and buy it back later. This is commonly used as part of a **spread** to limit risk.

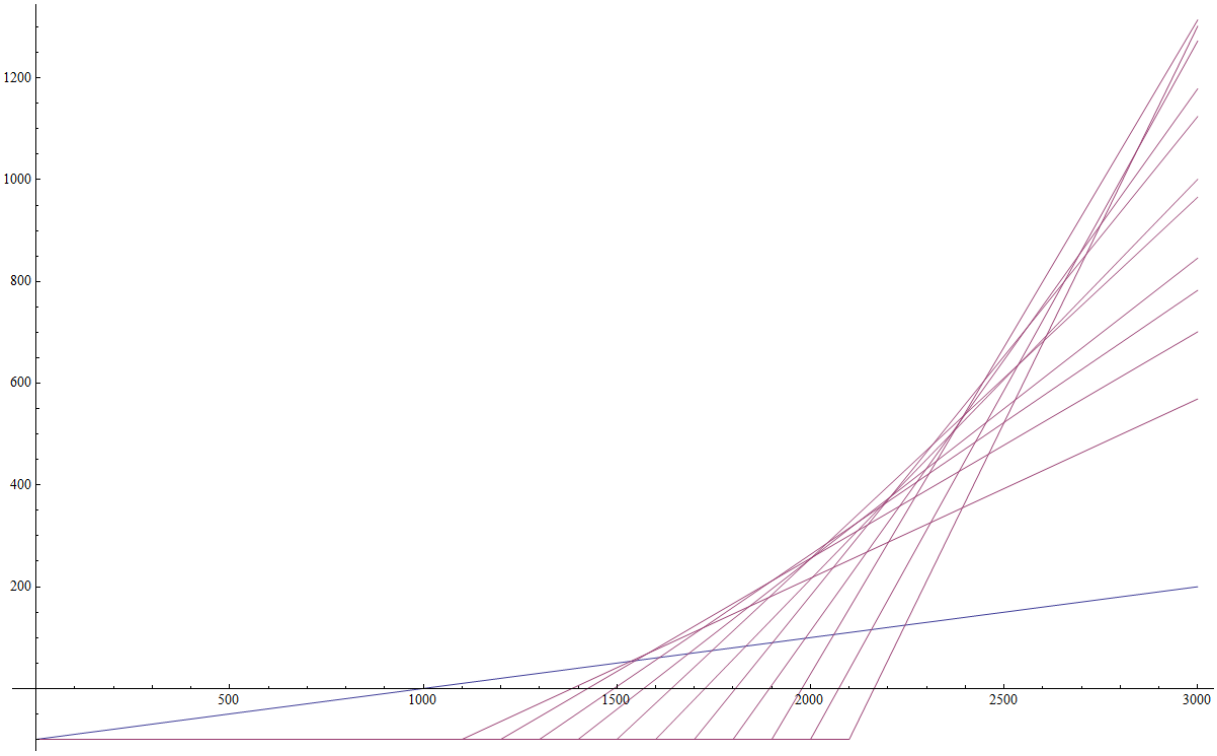
2.6 What is a Spread?

A **spread** is a combination of two or more option positions. For example, you might buy one call option at a $500 strike and sell another call option at a $550 strike. The sold call generates income that partially offsets the cost of the bought call, but it caps your maximum profit at $550.

Spreads let you **shape your risk/reward profile**—limiting your maximum loss in exchange for capping your maximum gain, or vice versa. CallCulator helps you build and analyze these combinations.

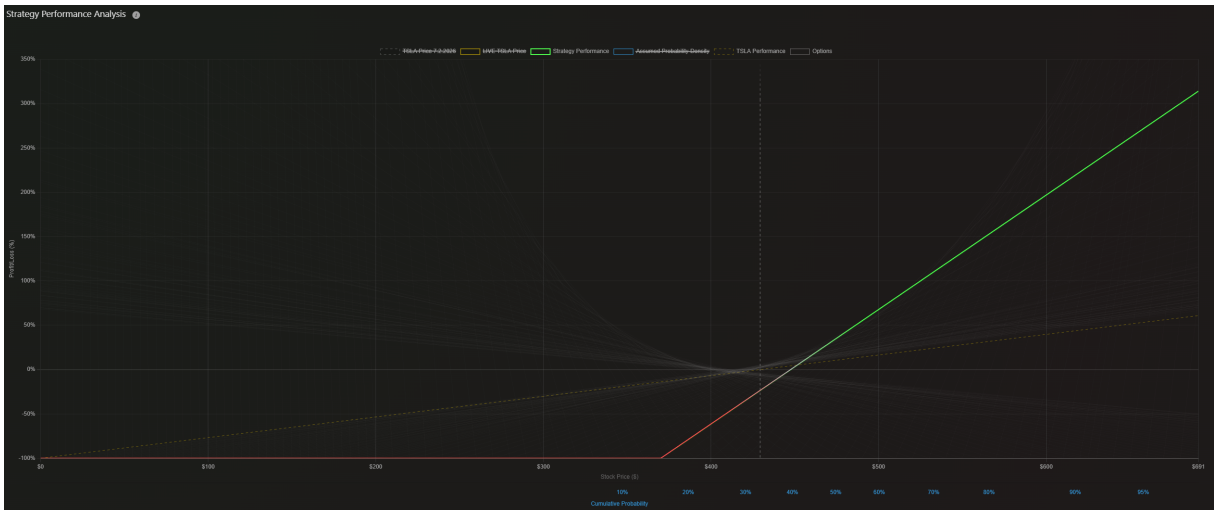
2.7 Visualizing Option Performance

The graph below shows the percentage gain or loss of different call options (red lines) compared to simply owning the stock (blue line):



Red lines: various call options. Blue line: owning the stock directly.

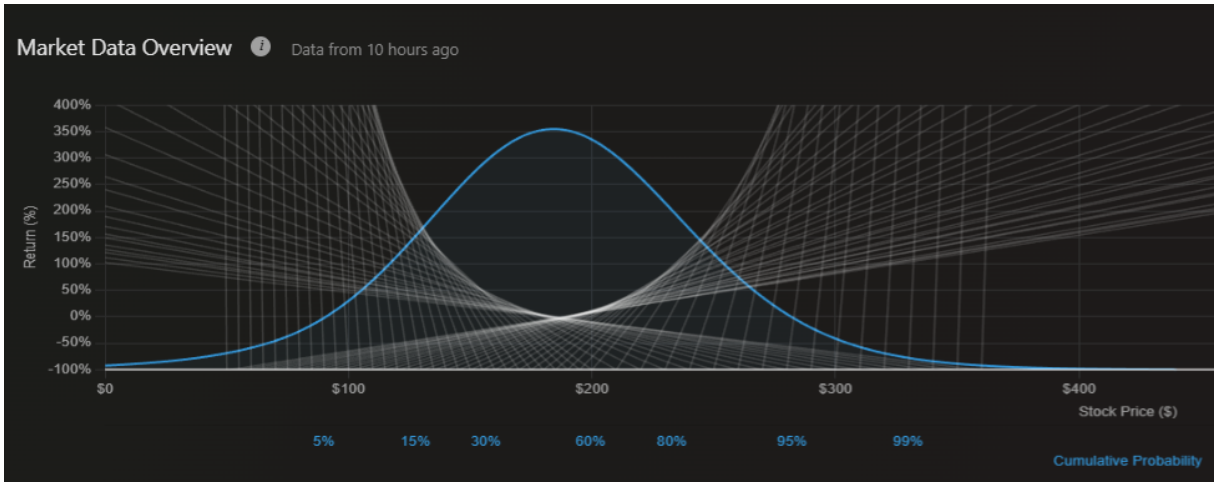
Notice how the red lines are much steeper than the blue line. A 10% rise in the stock price might translate to a 50% or even 200% rise in a call option's value. But if the stock doesn't reach the strike price, the option goes to zero—a 100% loss. This is the leverage effect in action.



A single call option's performance at expiration.

3 Understanding the Market Data Overview

When you select a ticker and expiration date, CallCulator shows a **Market Data Overview** chart:



Market Data Overview for a stock with options expiring on a selected date.

This chart displays:

- **Thin white lines:** Each line represents the performance of one available option (call or put) across different stock prices.
- The **Implied Probability Distribution (PDF)**: the blue curve showing what the market "believes" the stock price will be at expiration. In the example above, the peak is around $180, meaning the market considers $180 the most likely price at expiration and an uncertainty encoded by how spread out the curve is. This curve can also have more complicated shapes with multiple peaks. If it has two peaks for example, that means that the market believes that there is a fork-in-the-road moment for this stock/company at some point, splitting the probabilities of outcomes.
- The **Cumulative Distribution Function (CDF)**: shows the probability that the stock will be *below* a given price.

4 Using CallCulator: Basic Calculation Mode

The Basic Calculation mode lets you manually define an option strategy and instantly see how it would perform across different stock prices.

4.1 Step 1: Enter a Ticker

Type a stock ticker symbol (e.g., `TSLA`, `AAPL`, `MSFT`) into the ticker input field and press Enter or click Select. CallCulator will fetch the current stock price from live market data and load the full options chain (all available strikes and expiration dates).

4.2 Step 2: Choose an Expiration Date

A list of available expiration dates will appear. Click on the date you are interested in. This filters the available options to that specific expiration date.

4.3 Step 3: Build Your Strategy

You can add **legs** to your strategy:

- **Buy Call / Buy Put:** Standard long positions.
- **Sell Call / Sell Put:** Short (write) positions. These generate income but carry risk.
- **Weight (%):** Each leg has a weight expressed as a percentage, representing how much of your total capital is allocated to that leg. For example, if you have two legs at 60% and 40%, that means 60% of your investment goes into the first option and 40% into the second.

4.4 Step 4: View Results

Once your strategy is defined, CallCulator computes and displays:

- **Strategy Performance Chart:** A graph showing your percentage gain/loss (y-axis) at every possible stock price (x-axis) at expiration.
- **Black-Scholes Table:** A color-coded table showing estimated option values over time across different stock prices. Green means profit, red means loss.

  The table axes are:

  - **X-axis (Time):** Time progresses from left (today) to right (expiration date).
  - **Y-axis (Price):** Possible share prices of the underlying stock.

  The cell at coordinate (x, y) shows the estimated P/L of your strategy at that specific future time and stock price. The rightmost column (at expiration) corresponds exactly to the values in the Strategy Performance Chart above it (just rotated 90 degrees). Values at expiration are certain (intrinsic value), while values earlier in time are theoretical estimates based on the Black-Scholes model.
- **Monte-Carlo CAGR Statistics:** A simulation-based estimate of the compound annual growth rate of your strategy over many repetitions.

4.4.1 Static vs. Dynamic IV in the Black-Scholes Table

By default, the Black-Scholes table uses a **static** implied volatility (IV) for each option leg, calibrated from current market prices. This means the model assumes volatility stays the same no matter where the stock moves.

In reality, volatility changes when stocks move significantly:

- **When stocks drop sharply**, investors panic and rush to buy protective options, which drives volatility *up*. The company also becomes riskier (more debt relative to its shrinking equity).
- **When stocks rise sharply**, panic subsides and volatility tends to *decrease*.
- **Any extreme move** (up or down) can signal a shift to a more volatile market regime, pushing volatility higher in both directions.

CallCulator lets you model this with the **Dynamic IV** toggle in Search Parameters. When enabled, you set a **Skew** value that controls how much IV changes when the stock moves:

- **Skew = −1** (typical for stocks): If the stock drops 10%, each option's IV increases by about 10% of its base value. If it rises 10%, IV decreases by about 10%.
- **Skew = 0**: Same as static IV — no change.

The Black-Scholes table then shows a more realistic picture of how your strategy might perform. You can hold the **Show IV X-ray** text above the table to peek at the assumed IV in each cell.

Tip: For most stock-based strategies, a skew between –2 and –0.5 is realistic. The default of –1 is a good starting point.

4.5 Step 5: Share Your Results

Click the **Share** button to generate a public link. Anyone with the link can view a read-only summary of your analysis. Each view is counted automatically.

5 Using CallCulator: Probability & Risk Mode

This is CallCulator's most powerful mode. Instead of you picking options manually, you tell CallCulator *what you believe* about the stock's future and *how much risk you can accept*. The system then searches through millions or even billions of possible option combinations to find the best one for you. These calculations would take a normal computer hours to weeks or even months to compute even with a powerful multi-core processor and parallel processing. CallCulator uses a sophisticated way to distribute the task and compute it in the cloud within seconds.

5.1 Step 1: Enter a Ticker

Same as Basic mode: type a stock symbol and press Enter. The system loads the stock price and full options chain.

5.2 Step 2: Choose an Expiration Date

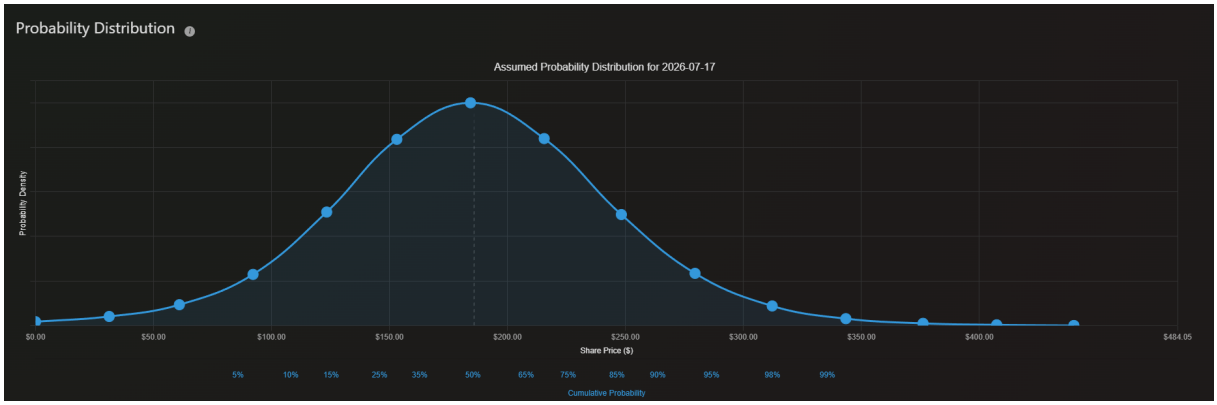
Select the future date you want to analyze. The system loads all available options and the implied probability distributions and displays it in the Market Data Overview graph.

5.3 Step 3: Draw Your Probability Distribution

Instead of a single price target, you express your belief as a **curve**:

- The curve shows how likely you think each future price is.
- A tall peak at $180 means you think $180 is the most probable price.
- A wide, flat curve means you are uncertain—many prices seem almost equally likely.
- A narrow, tall curve means you are very confident about a specific price.

Think of it this way: if you had to bet on where the stock will be, the curve represents all your bets at once, weighted by confidence.



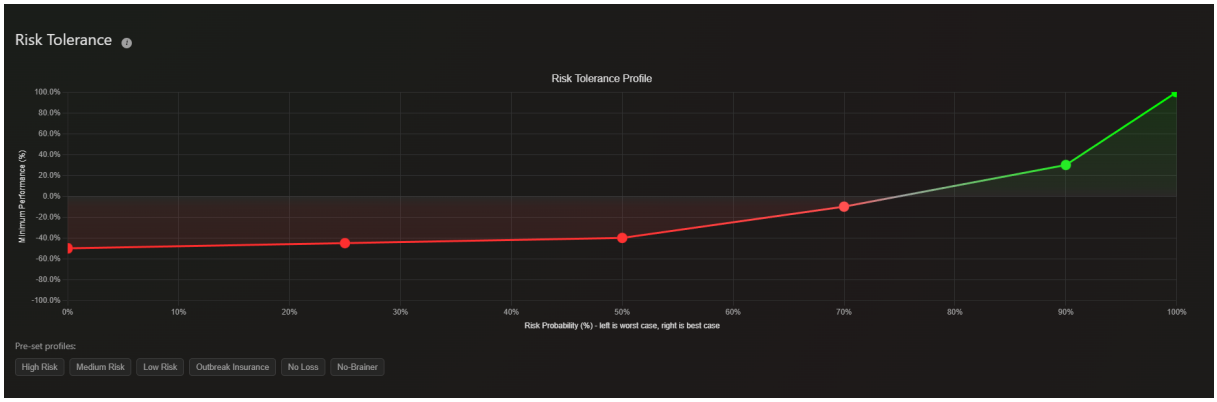
An example probability distribution: the user believes the stock will most likely be around $180.

5.4 Step 4: Set Your Risk Tolerance

Your risk tolerance describes, for every probability level, the minimum return you would accept. Think of it as a continuous boundary:

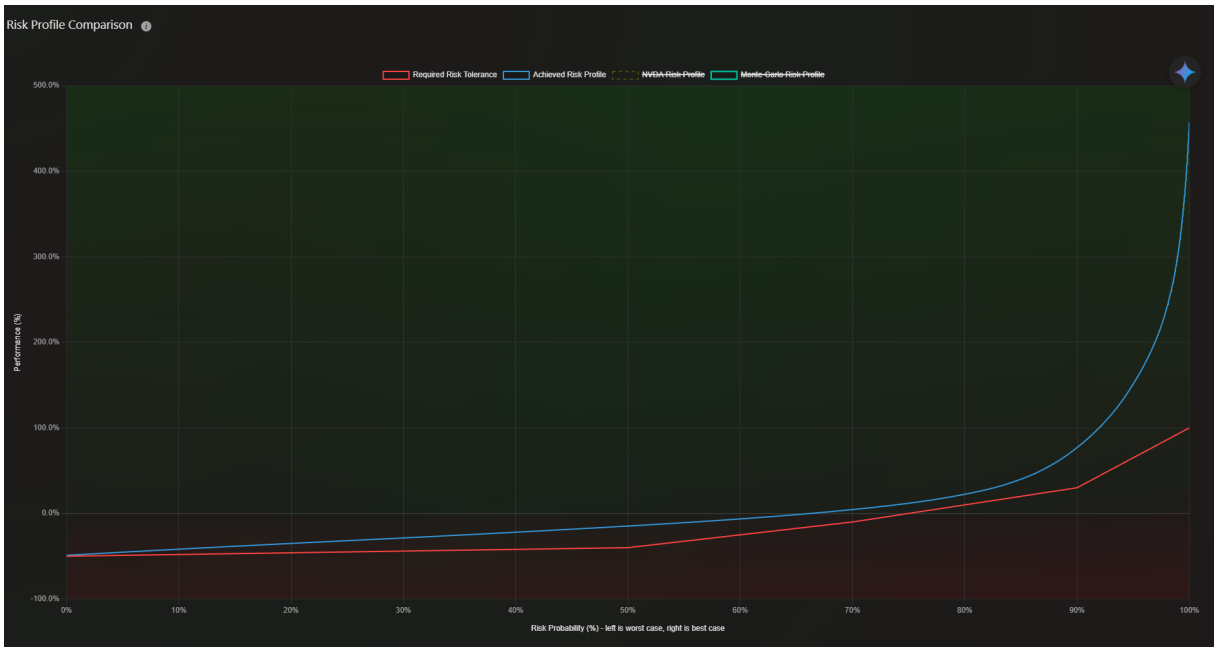
- "In the absolute worst-case of outcomes, I want to lose at most 50%."
- "In the worst 10% of outcomes, I want to lose at most 30%."
- "In the worst 40% of outcomes, I want to lose at most 5%."
- "In 50% of cases, I want to be profitable."
- "In the best 10% of outcomes, I want at least +80%."

This creates a curve from worst case (left) to best case (right). You draw this curve on CallCulator by adjusting control points or clicking on pre-set profiles:



The user's risk tolerance curve: a boundary that any acceptable strategy must stay above at every point.

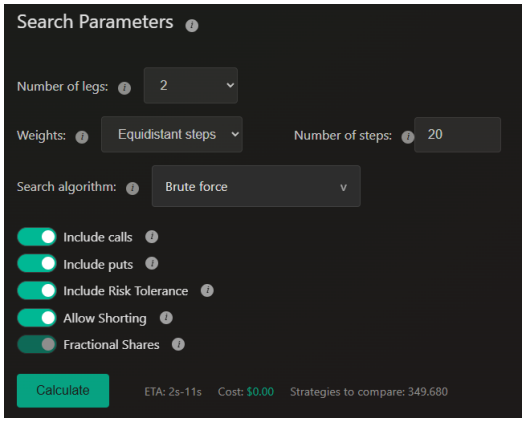
CallCulator will only suggest strategies whose risk profile stays *above* this boundary at every probability level. Here is an example of a strategy that satisfies the risk tolerance:



The found strategy's risk profile (blue) compared to the user's tolerance (red). The blue line stays above the red line everywhere, meaning the strategy meets the user's requirements.

5.5 Step 5: Configure and Launch the Search

Before launching, you can configure the search parameters:



The search parameter panel.

Key concepts:

- **Legs:** The number of individual option positions in the strategy. A 2-leg strategy might be "Buy Call A + Sell Call B." A 3-leg strategy adds a third option.
- **Steps:** How finely the algorithm scans through possible weights. More steps means a more thorough search but takes longer and costs more.
- **Search Algorithm:** Currently, CallCulator offers two main algorithms:
  - **Brute Force:** Systematically evaluates every possible combination on a grid. This is rigorous but computationally expensive, limiting it to strategies with 2 or 3 legs.

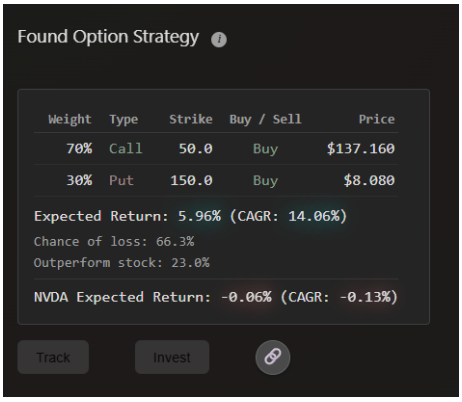
  - **Smart Search (GSGD):** A "Grid Search Gradient Descent" hybrid. It uses advanced mathematics (Sobol sequences) to intelligently scatter starting points (seeds) across the possibilities, and then uses an adaptive hill-climbing method (Gradient Descent with Powell-Wolfe steps) to find the local optimum from each seed. This allows finding optimal strategies in complex 4- or 5-leg scenarios that would be impossible to compute with Brute Force.

- **Computational Complexity:** The number of strategies to compare grows rapidly with the number of legs and steps. For example, doubling the steps can quadruple (or more) the number of combinations, which increases both computation time and cost. More legs allow more complex strategies but increase computation time exponentially. 3-leg searches go into the billions of strategies to compare and are very costly. 4-leg searches are utterly infeasible with a Brute force approach. Smarter algorithms vastly improve this.

Click the search button to launch. The backend distributes the work in the cloud, turning a calculation that takes hours, weeks or even months on high-end personal CPUs into a computation that is finished within seconds.

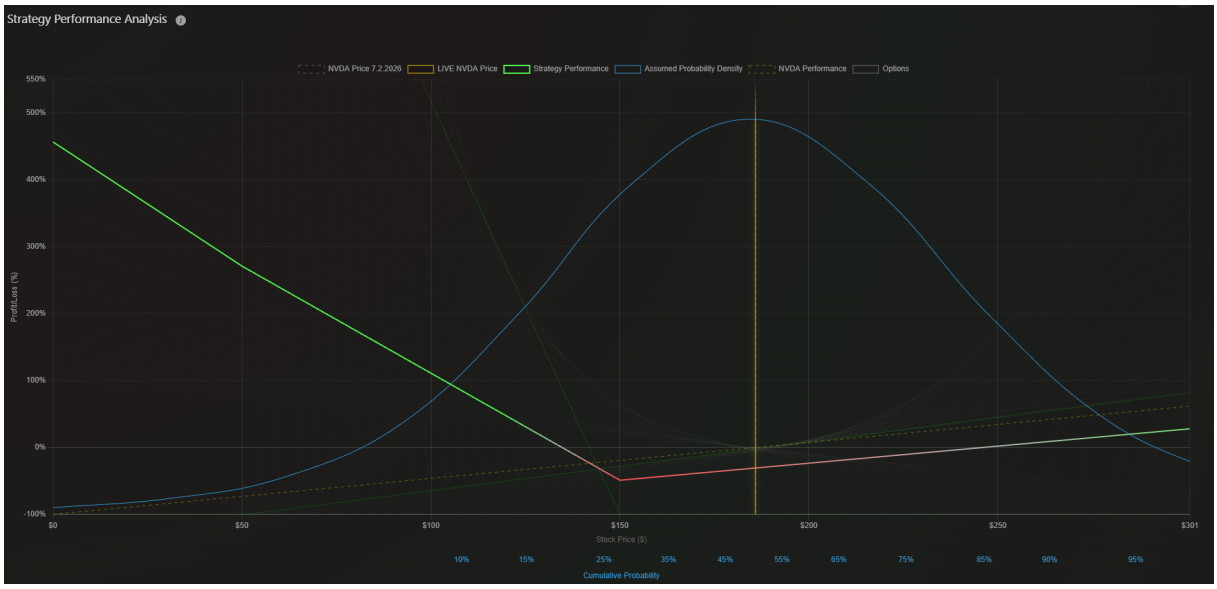
5.6 What You Get Back

The Found Strategy shows the specific spread that was the best out of all those millions and billions of potential strategies.



The found strategy card showing the option legs, their weights, and key statistics.

Strategy Performance Analysis shows how the strategy performs across all possible stock prices at expiration:



Performance chart: the strategy's percentage return (y-axis) at every possible stock price (x-axis).

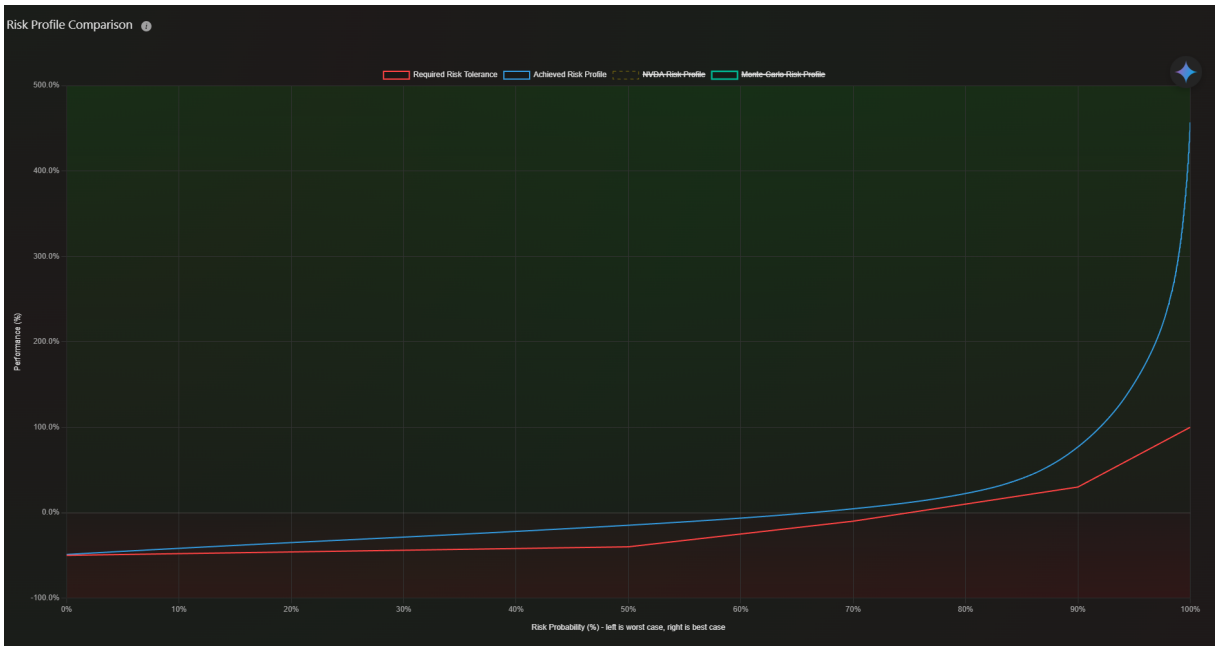
Black-Scholes Table shows the estimated value of the strategy over time. Each cell is color-coded: green means profit, red means loss. The **blue glow on the right edge** represents the Assumed Probability Density you provided—where it glows more intensely, the stock is more likely to end there (according to your input):

Time → / Price ↓	2026																				
	Feb 7	Feb 15	Feb 23	Mar 3	Mar 11	Mar 19	Mar 27	Apr 4	Apr 12	Apr 20	Apr 28	May 6	May 14	May 22	May 31	Jun 8	Jun 16	Jun 24	Jul 2	Jul 10	Jul 18
301	30.1	29.8	29.5	29.3	29.1	28.9	28.7	28.6	28.5	28.4	28.3	28.3	28.2	28.2	28.1	28.1	28.1	28.1	28.0	28.0	28.0
293	26.6	26.3	26.0	25.7	25.5	25.2	25.0	24.9	24.7	24.6	24.5	24.4	24.4	24.3	24.3	24.3	24.3	24.2	24.2	24.2	24.2
286	23.2	22.8	22.5	22.2	21.9	21.6	21.4	21.2	21.0	20.8	20.7	20.6	20.6	20.5	20.5	20.4	20.4	20.4	20.4	20.4	20.3
278	19.9	19.4	19.0	18.7	18.3	18.0	17.7	17.5	17.3	17.1	17.0	16.8	16.7	16.7	16.6	16.6	16.6	16.6	16.5	16.5	16.5
271	16.6	16.2	15.7	15.3	14.9	14.5	14.2	13.9	13.6	13.4	13.2	13.1	13.0	12.9	12.8	12.8	12.7	12.7	12.7	12.7	12.7
263	13.6	13.0	12.5	12.0	11.5	11.1	10.7	10.4	10.0	9.75	9.52	9.33	9.17	9.06	8.99	8.94	8.91	8.88	8.86	8.84	8.81
256	10.6	10.0	9.43	8.86	8.32	7.81	7.34	6.91	6.52	6.18	5.88	5.63	5.43	5.28	5.18	5.11	5.07	5.04	5.02	5.00	4.98
248	7.91	7.21	6.54	5.88	5.26	4.67	4.11	3.59	3.12	2.69	2.32	2.00	1.74	1.53	1.39	1.29	1.24	1.21	1.18	1.16	1.14
241	5.42	4.63	3.86	3.12	2.40	1.71	1.05	0.43	-0.14	-0.66	-1.13	-1.54	-1.89	-2.16	-2.37	-2.51	-2.59	-2.63	-2.66	-2.68	-2.70
233	3.20	2.32	1.45	0.60	-0.22	-1.02	-1.79	-2.52	-3.21	-3.85	-4.44	-4.96	-5.41	-5.79	-6.07	-6.28	-6.40	-6.46	-6.49	-6.52	-6.54
226	1.32	0.33	-0.64	-1.60	-2.54	-3.46	-4.35	-5.21	-6.03	-6.81	-7.53	-8.20	-8.79	-9.29	-9.69	-9.99	-10.2	-10.3	-10.3	-10.4	-10.4
218	-0.17	-1.26	-2.34	-3.42	-4.48	-5.53	-6.56	-7.56	-8.54	-9.47	-10.4	-11.2	-11.9	-12.6	-13.2	-13.6	-13.9	-14.1	-14.2	-14.2	-14.2
211	-1.18	-2.38	-3.58	-4.77	-5.97	-7.16	-8.33	-9.49	-10.6	-11.7	-12.8	-13.8	-14.8	-15.7	-16.5	-17.1	-17.6	-17.9	-18.0	-18.0	-18.1
203	-1.63	-2.94	-4.25	-5.57	-6.90	-8.23	-9.56	-10.9	-12.2	-13.5	-14.8	-16.0	-17.2	-18.4	-19.4	-20.3	-21.0	-21.5	-21.8	-21.9	-21.9
196	-1.42	-2.83	-4.26	-5.71	-7.17	-8.64	-10.1	-11.6	-13.1	-14.6	-16.1	-17.6	-19.1	-20.5	-21.9	-23.1	-24.2	-25.0	-25.5	-25.7	-25.7
188	-0.44	-1.95	-3.48	-5.04	-6.63	-8.24	-9.88	-11.5	-13.2	-14.9	-16.7	-18.4	-20.2	-21.9	-23.7	-25.3	-26.9	-28.2	-29.1	-29.5	-29.6
180	1.44	-0.16	-1.78	-3.45	-5.15	-6.88	-8.66	-10.5	-12.3	-14.2	-16.2	-18.2	-20.2	-22.3	-24.5	-26.6	-28.7	-30.7	-32.3	-33.3	-33.4
173	4.35	2.69	0.99	-0.76	-2.55	-4.38	-6.27	-8.22	-10.2	-12.3	-14.5	-16.7	-19.0	-21.4	-23.9	-26.5	-29.2	-31.9	-34.6	-36.7	-37.2
165	8.43	6.73	4.98	3.19	1.34	-0.56	-2.53	-4.57	-6.68	-8.88	-11.2	-13.6	-16.1	-18.8	-21.6	-24.6	-27.9	-31.4	-35.2	-39.1	-41.1
158	13.8	12.1	10.4	8.57	6.70	4.77	2.78	0.70	-1.46	-3.72	-6.08	-8.57	-11.2	-14.0	-17.1	-20.3	-24.0	-28.1	-32.8	-38.7	-44.9
150	20.7	19.1	17.3	15.6	13.7	11.8	9.85	7.80	5.66	3.43	1.08	-1.39	-4.02	-6.84	-9.88	-13.2	-16.9	-21.2	-26.2	-33.0	-48.8
143	29.2	27.6	26.0	24.3	22.5	20.7	18.9	16.9	14.9	12.8	10.6	8.22	5.74	3.11	0.27	-2.81	-6.21	-10.1	-14.5	-20.1	-26.2
135	39.5	38.0	36.5	34.9	33.3	31.7	30.0	28.2	26.4	24.5	22.5	20.4	18.2	16.0	13.5	11.0	8.24	5.30	2.16	-0.94	-2.10
128	51.6	50.3	49.0	47.6	46.2	44.7	43.2	41.7	40.1	38.5	36.9	35.2	33.5	31.7	29.9	28.0	26.1	24.3	22.7	21.8	22.0
120	65.6	64.5	63.4	62.2	61.1	59.9	58.7	57.5	56.2	55.0	53.7	52.5	51.2	50.0	48.8	47.7	46.7	46.0	45.5	45.6	46.1
113	81.6	80.7	79.8	78.9	78.0	77.1	76.2	75.3	74.4	73.6	72.7	71.9	71.2	70.5	69.9	69.5	69.2	69.1	69.3	69.7	70.1
105	99.3	98.7	98.1	97.4	96.8	96.2	95.6	95.1	94.5	94.0	93.6	93.2	92.9	92.6	92.5	92.5	92.6	92.9	93.3	93.8	94.2
98	119	118	118	118	117	117	117	116	116	116	116	116	116	116	116	116	117	117	117	118	118
90	140	140	140	139	139	139	139	139	139	139	139	139	139	140	140	140	141	141	141	142	142
83	162	162	162	162	162	162	162	163	163	163	163	163	164	164	164	164	165	165	166	166	166
75	186	186	186	186	186	186	187	187	187	187	187	188	188	188	188	189	189	189	190	190	191
68	210	210	210	210	211	211	211	211	212	212	212	212	213	213	213	213	213	214	214	214	215
60	234	235	235	235	235	236	236	236	236	237	237	237	237	238	238	238	238	238	238	238	239
53	259	260	260	260	261	261	261	261	262	262	262	262	263	263	263	263	263	263	263	263	263
45	285	285	286	286	286	287	287	287	287	288	288	288	288	289	289	289	289	289	289	289	289
38	311	311	312	312	312	313	313	313	314	314	314	314	315	315	315	316	316	316	317	317	317
30	337	338	338	338	339	339	340	340	340	341	341	341	342	342	343	343	343	344	344	345	345
23	364	365	365	365	366	366	367	367	368	368	368	369	369	370	370	371	371	372	372	373	373
15	392	392	392	393	393	394	394	395	395	396	396	397	397	398	398	399	399	400	400	401	401
8	419	420	420	421	421	422	422	423	423	424	424	425	425	426	426	427	427	428	428	429	429
0	447	448	448	449	449	450	450	451	451	452	452	453	453	454	454	455	455	455	456	456	457

Black-Scholes table with probability glow on the right edge.

Additional results include:

- **Risk Profile Comparison:** A chart overlaying your tolerance (red) and the strategy's risk (blue).



Example of a successful Risk Profile Comparison: the blue line (strategy) stays above the red line (tolerance).

- **Expected Return:** The average return, weighted by your probability distribution.
- **Chance of Loss:** The probability (according to your belief) that the strategy loses money.
- **Outperform Probability:** The chance that the strategy beats simply buying the stock.
- **Monte-Carlo CAGR:** Simulated long-term growth rate (more on this in Section 7).

6 Using CallCulator: Max Min Mode

Max Min mode takes a completely different approach: instead of maximizing expected return, it maximizes the **worst-case outcome**. The question it answers is: "What is the best strategy if I want to minimize my losses in the worst possible scenario?"

This is useful for very conservative investors or when you have no strong opinion about where the stock is going but want the safest possible option play. Assuming an efficient market, the return you can expect from this is roughly the Risk-Free-Rate, set my the central bank. Mispricings in the market can result in this return to be greater than the Risk-Free-Rate (usually 2% - 4% annually) but are rare and hard to find. If they exist, however, CallCulator can find these Mispricings and capitalize on them.

6.1 Single Stock Mode

In Single mode, you pick one stock and one expiration date. The optimizer finds the spread where even if everything goes wrong, your loss is as small as possible (or even still a profit).

Workflow:

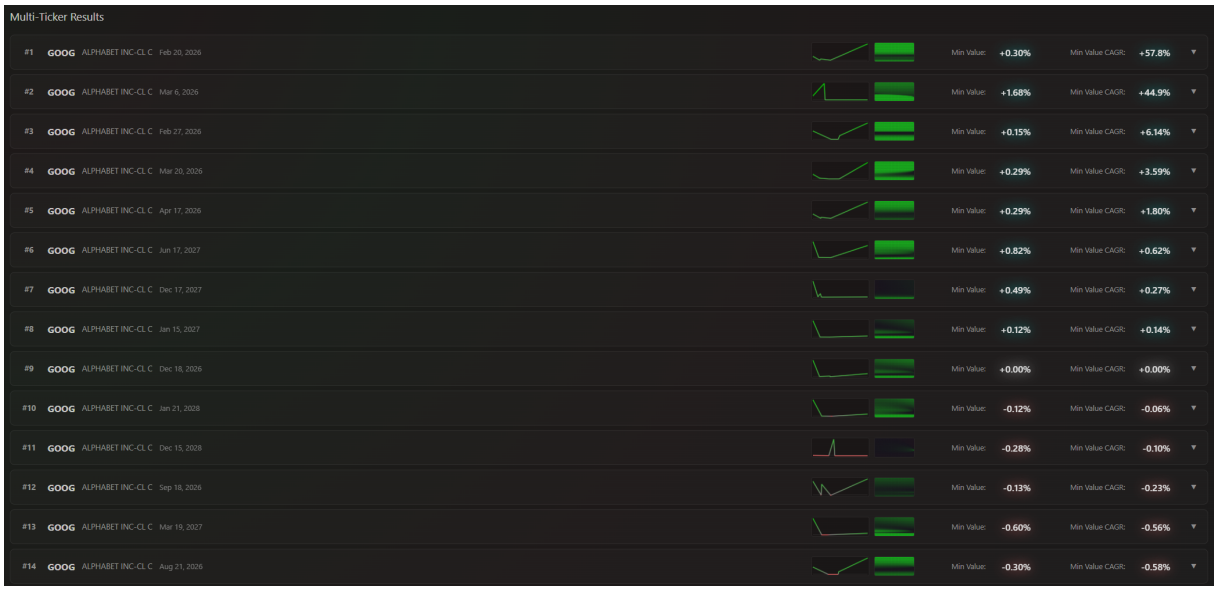
1. Enter a ticker symbol and select it.
2. Choose an expiration date.
3. Choose Search Parameters
4. The system searches for the spread with the best worst-case return.

6.2 Multi Stock Mode

In Multi mode, you can add **multiple stocks** to analyze at once so you don't have to do every one individually. In the result, you can compare which calculation found a better strategy.

Workflow:

1. Enter a ticker and click "Add" to add it to your portfolio.
2. Repeat for as many stocks as you want.
3. Choose expiration dates for each stock.
4. Choose Search Parameters
5. The system calculates them all and displays them for comparison.



6.3 A More Flexible Approach: Optimizing for the "Bad But Not Worst" Case (In Development)

Pure Max Min is extremely paranoid: it guarantees protection even if the absolute worst scenario happens (e.g., the stock goes to $0 or $1,000,000). But in reality, some extreme scenarios are so rare or so expensive to protect against that they might not be worth it.

Imagine you say: "I'll accept a 5% chance of a big loss, but in 95% of realistic scenarios, I want the best possible outcome." We will call this **Soft Minimum maximization** or **Max Min Soft**.

Instead of optimizing for the absolute worst-case, you optimize for the 5th percentile (or 10th percentile, or whatever you choose). This frees up budget from the worst 5% of scenarios and reinvests it into making the other 95% much better.

Example: - **Pure Max Min:** Guarantees $1,000 minimum across all 10,000 possible stock price outcomes. - **Soft Minimum (5th percentile):** 500 scenarios (the worst 5%) are allowed to fail. The remaining 9,500 scenarios get a minimum of $1,500.

For long-term investors, the soft minimum often provides more sensible protection because it acknowledges that truly catastrophic outcomes are rare and may not be worth over-hedging.

7 The Logic of Investing: Why Risk Management Matters

7.1 Alice and Bob: A Story of Risk and Ruin

To understand why sophisticated risk tools are essential, consider this thought experiment.

Alice offers Bob a weighted coin flip: **80% Heads**, **20% Tails**.

- **Heads:** Bob's investment doubles (+100%).
- **Tails:** Bob loses everything (-100%).

One rule: Bob must re-invest his entire pot each flip.

Bob calculates: $2 \times 0.80 + 0 \times 0.20 = 1.60$, or +60% average return per flip. He jumps in.

Result: After just 3 flips (Heads, Heads, Tails), Bob has $0. One bad flip wiped him out entirely.

The lesson is mathematical: no matter how good the odds, if the probability of Tails is non-zero, long-term ruin is certain when betting everything:

$$\lim_{n \to \infty} (1 - 0.8^n) = 1$$

7.2 The Solution: Don't Bet Everything (Diversification)

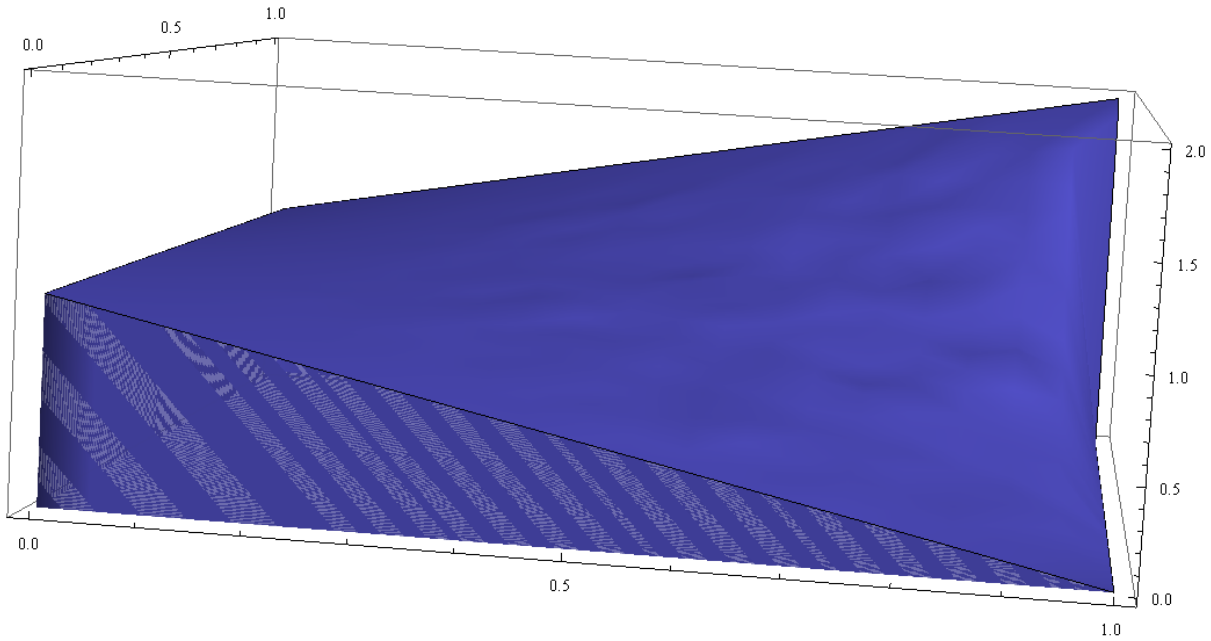
If Bob bets only half his money each flip, a loss only halves his pot instead of destroying it. Simulations show that with optimal position sizing, Bob becomes a billionaire after just 81 flips on average, starting from $1.

7.3 Beyond the Coin Flip: The Ergodicity Problem

This coin-flip example might seem extreme, but the core issue persists in almost all repeated investing. The mathematical term for this is **ergodicity breaking**.

In financial markets, the **Expected Return** (average of all possible outcomes) is often very different from the **Median Outcome** (what actually happens to most people). A strategy might have a positive Expected Return but still lead to a loss for 90% of investors over time because a few massive winners skew the average.

When you invest repeatedly (re-investing your gains), you don't experience the average of parallel universes; you experience one single path through time. If that path hits zero, you are out of the game. This is why maximizing Expected Return is not enough—you must manage the risk of the "time-average" diverging from the "ensemble-average."



Average return per flip depending on the fraction of capital wagered (x-axis) and win probability (y-axis).

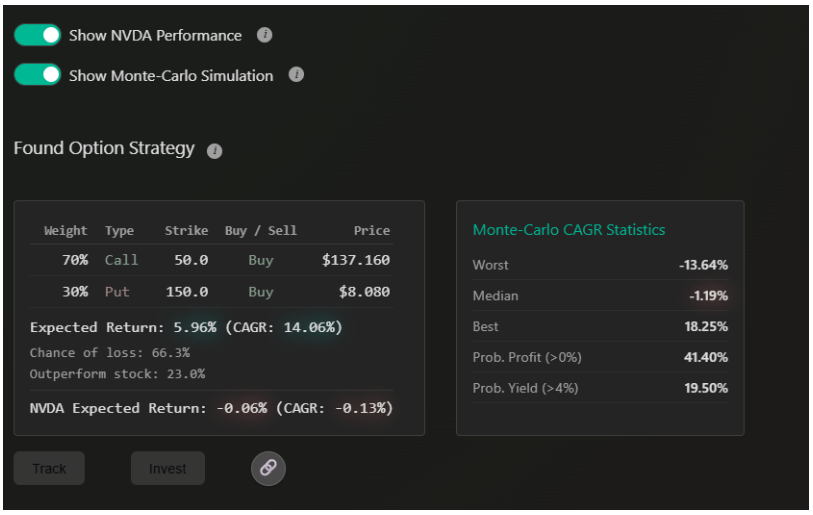
7.4 Monte-Carlo Simulation: Revealing the Hidden Risk

The coin-flip example shows that **Expected Return alone is not enough** to judge an investment. Two strategies can have the same expected return but wildly different long-term outcomes depending on how their gains and losses are distributed.

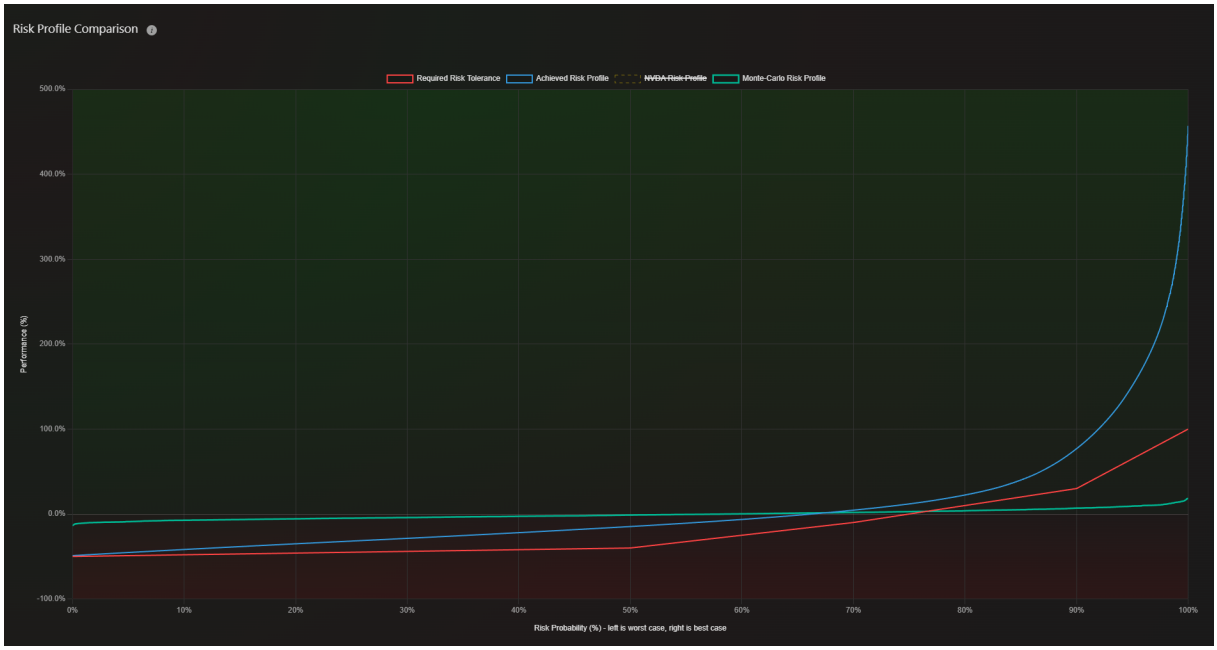
Monte-Carlo simulation is a tool that reveals this hidden risk. It works by:

1. Simulating thousands of possible future stock price outcomes, drawn from the probability distribution.
2. For each outcome, calculating the strategy's return.
3. Repeating this process as if you were re-investing over and over (compounding).
4. Reporting the average compound growth rate (**CAGR**) across all simulations.

If a strategy has a high expected return but a high chance of large losses, the Monte-Carlo median CAGR will be low (or negative)—exposing the hidden risk that a simple average does not capture.



Found strategy shows positive Expected Return but Monte-Carlo reveals a negative Median Retrun.



Risk Profile Comparison with Monte-Carlo insights.

7.5 Why Median CAGR Could Be the Better Goal

Currently, CallCulator's Probability & Risk mode finds the strategy with the highest **expected return**—the average outcome across all possible scenarios. But as the Alice & Bob story shows, the average can be misleading when you are investing repeatedly.

Consider two strategies:

- **Strategy A ("The Sniper"):** Puts all money on a single, highly leveraged bet. If it hits, you make 500%. If it misses, you lose everything. Expected return: +60%. But over time, one bad outcome wipes you out.
- **Strategy B ("The Farmer"):** Spreads money across many outcomes proportional to how much the market is mispricing them. Expected return: +30%. But over time, you consistently grow because you never go to zero.

Strategy A has the higher *average* return, but Strategy B has the higher *median* long-term growth. If you ran 10,000 simulations of each strategy over 20 years, the *typical* investor using

Strategy B would end up wealthier than the typical investor using Strategy A—even though A looks better on paper.

This is because the median CAGR captures what actually happens to *most* people over time, while the expected return is skewed by a few extreme winners.

What this means for CallCulator: You may notice a placeholder toggle in Search Parameters labeled "Use Monte-Carlo Median as objective function." When this feature is activated, the optimizer will switch from finding the strategy with the highest average return to finding the strategy with the highest median long-term growth rate—the strategy that makes the typical investor wealthiest over time, not just the luckiest one.

8 Mathematical Constructions: The Six Optimization Regimes

The different ways CallCulator can search for a "best" strategy correspond to six mathematical **optimization regimes**. Each regime answers a different question (e.g., "maximize average return" vs. "maximize the worst-case outcome") and leads to a different type of optimal payoff. This section gives a simple, non-technical overview.

8.1 Regime 0: The Scavenger (Micro-Arbitrage)

Before building a strategy from your beliefs, the **Scavenger** looks for options that are mispriced relative to the rest of the market curve—e.g., one strike is unusually cheap or expensive. The idea: buy options that are "cheap" compared to the theoretical curve and sell ones that are "expensive." This can be combined with other regimes: when turning a target payoff into real option legs, CallCulator can prefer legs that are cheap, which lowers cost and frees budget for a better strategy.

8.2 Regime 1: The Sniper (Unconstrained Maximization)

Goal: Maximize expected return with a fixed budget.

The **Sniper** puts all capital on the single outcome where the market is most wrong relative to your belief. In theory that is an infinitely sharp bet (a "spike"); in practice it is approximated by a very tight spread. This gives the highest possible average return, but the *median* outcome over many trials is often zero—one bad outcome wipes you out. It matches the "Strategy A" example from the Alice & Bob story.

8.3 Regime 2: The Insurer + Sniper (Constrained Optimization)

Goal: Maximize expected return *subject to* your risk tolerance curve.

First, buy the cheapest "insurance" that satisfies your risk floor (so that at every probability level your payoff stays above your minimum acceptable return). Then, use any remaining budget for a Sniper-style bet to maximize expected return. Summary: **insure, then speculate**. This is what CallCulator's **Probability & Risk** mode implements.

8.4 Regime 3: The Farmer (Log-Optimal / Median CAGR)

Goal: Maximize long-term geometric growth (median CAGR), not average return.

The **Farmer** spreads capital across *all* outcomes in proportion to how mispriced they are—instead of one spike, you get a smooth curve that never hits zero. That avoids ruin and maximizes the growth rate that *most* investors actually experience over time. It matches "Strategy B" in the Alice & Bob story. In CallCulator, the placeholder "Use Monte-Carlo Median as objective function" would switch the optimizer to this regime.

8.5 Regime 4: The Bunker (Max Min)

Goal: Maximize the worst-case outcome.

The **Bunker** wants the same payoff no matter where the stock ends up—a flat line. That way, even in the worst scenario, you do as well as possible. In practice this is approximated with instruments like a **box spread** (synthetic risk-free payoff). CallCulator's **Max Min** mode implements this regime.

8.6 Regime 5: The Sentinel (Soft Minimum)

Goal: Maximize a higher percentile (e.g., the 5th percentile), not the absolute minimum.

The pure Bunker protects against *every* outcome, including extremely rare ones. The **Sentinel** accepts a "sacrifice zone" (e.g., the worst 5% of outcomes) and uses the saved budget to raise the floor for the other 95%. This is the idea behind **Max Min Soft** (see the Max Min section above). Implementation is planned for future releases.