

THE COMPLETE GUIDE TO



Monte Carlo

AN EMONEY WEBINAR

With Chris Hershey and Jacob Leise from **eMoney**
Advisor

WEBINAR HOSTS



CHRIS HERSHEY

Senior Financial Planning Analyst



JACOB LEISE

Content Manager

WHAT TOUGH QUESTIONS

DO YOU HEAR FROM

YOUR CLIENTS?

MONTE CARLO??



2 GOALS

- 1. Provide a *Conceptual* Understanding of Monte Carlo Methodology**
 - This will not be a highly technical analysis of the eMoney Monte Carlo Simulation
 - It will stay fairly high level so that you can feel comfortable explaining it to your clients.
- 2. Show the value of using this methodology with your clients**
 - More nuanced analysis of a financial plans (not just yes/no answers)
 - Clear demonstration of the value of a diversified portfolio
 - The effects of sequence of returns and market volatility on a plan.

MONTE CARLO – A SIMPLE DEFINITION

Monte Carlo - *adjective* Mon·te Car·lo \,män-tē-'kär-(,)lō\

Monte Carlo - of, relating to, or involving the use of random sampling techniques and often the use of computer simulation to obtain approximate solutions to mathematical or physical problems especially in terms of a range of values each of which has a calculated probability of being the solution.

IN OTHER WORDS...

Monte Carlo helps calculate probable outcomes to complex problems through simulation and random sampling.

MONTE CARLO – A NOTE ON THE NAME

- The process was officially recognized as viable scientific method during the 1940s when it was used by physicists at Los Alamos Laboratory who were studying the movement of sub-atomic particles in their attempt to construct a nuclear weapon.
- Because they could not solve this problem mathematically, they used random sampling techniques to calculate the probability that the particles would move a certain way.
- Due to the secretive nature of this project, the researchers at Los Alamos used a code name to refer to the type of methodology – Monte Carlo

MONTE CARLO AT WORK – A SIMPLE EXAMPLE

PROBLEM: I want to determine the probability that I will pull out the ace of spades from a deck of cards. **How do I solve this problem?**

1. **MATHEMATICALLY** – $1/52 = 1.92\%$ chance, OR,
2. **EMPIRICALLY** (*Monte Carlo methodology*) – I could shuffle the cards, pull out one card, record the result, place the card back in the deck, shuffle the cards...and repeat.

If I did this enough times, I would eventually be able to approximate that I have a 1.92% chance of pulling the ace of spades. By re-creating the process multiple times and recording the results, I can approximate solutions to complex problems.

A MORE RELEVANT *(but still simple)* EXAMPLE

Let's assume your client has the following.

- **\$100,000** invested in a **100% equity portfolio**
- **10** year time horizon
- **\$10,000** withdrawals over the course of the **next 10 years**.

SIMPLE QUESTION: Will the money last **10 years**?

How do you answer this?

THE LINEAR APPROACH

Using the linear approach, you might run some calculations and come with a projected annualized rate of return for all future years. It might look something like this.

2016	2017	2018	2019	2020	2021	2022	2023	2024	2025
5%	5%	5%	5%	5%	5%	5%	5%	5%	5%

How does this compare to the last 10 years?

2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
13.34%	3.86%	-39.02%	25.47%	13.87%	-0.51%	13.92%	30.44%	12.06%	0.92%	???

Source: Russell 1000 Index

SHORTCOMINGS OF LINEAR APPROACH:

Simplistic, either the money lasts or it doesn't...

1. Doesn't factor in Market Volatility or,
2. Doesn't show importance of sequence of returns

FACTOR IN CASH FLOWS

YEAR	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026
GROWTH	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05
BALANCE	\$105,000.00	\$ 99,750.00	\$94,237.50	\$88,449.38	\$82,371.84	\$75,990.44	\$69,289.96	\$62,254.46	\$54,867.18	\$47,110.54	\$38,966.06
WITHDRAWALS	\$10,000.00	\$10,000.00	\$10,000.00	\$10,000.00	\$ 10,000.00	\$10,000.00	\$10,000.00	\$10,000.00	\$10,000.00	\$10,000.00	\$10,000.00
EOY BALANCE	\$95,000.00	\$89,750.00	\$84,237.50	\$ 78,449.38	\$ 72,371.84	\$65,990.44	\$59,289.96	\$52,254.46	\$44,867.18	\$37,110.54	\$28,966.06

Will the money last **10 years**?

Yes, it will...*but* is this a good plan for your client?

THE MONTE CARLO APPROACH

We can introduce market volatility into our projections by running a few simple calculations.

Remember the Russell 1000 Index??

2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
13.34%	3.86%	-39.02%	25.47%	13.87%	-0.51%	13.92%	30.44%	12.06%	0.92%	???

Arithmetic Mean or Average

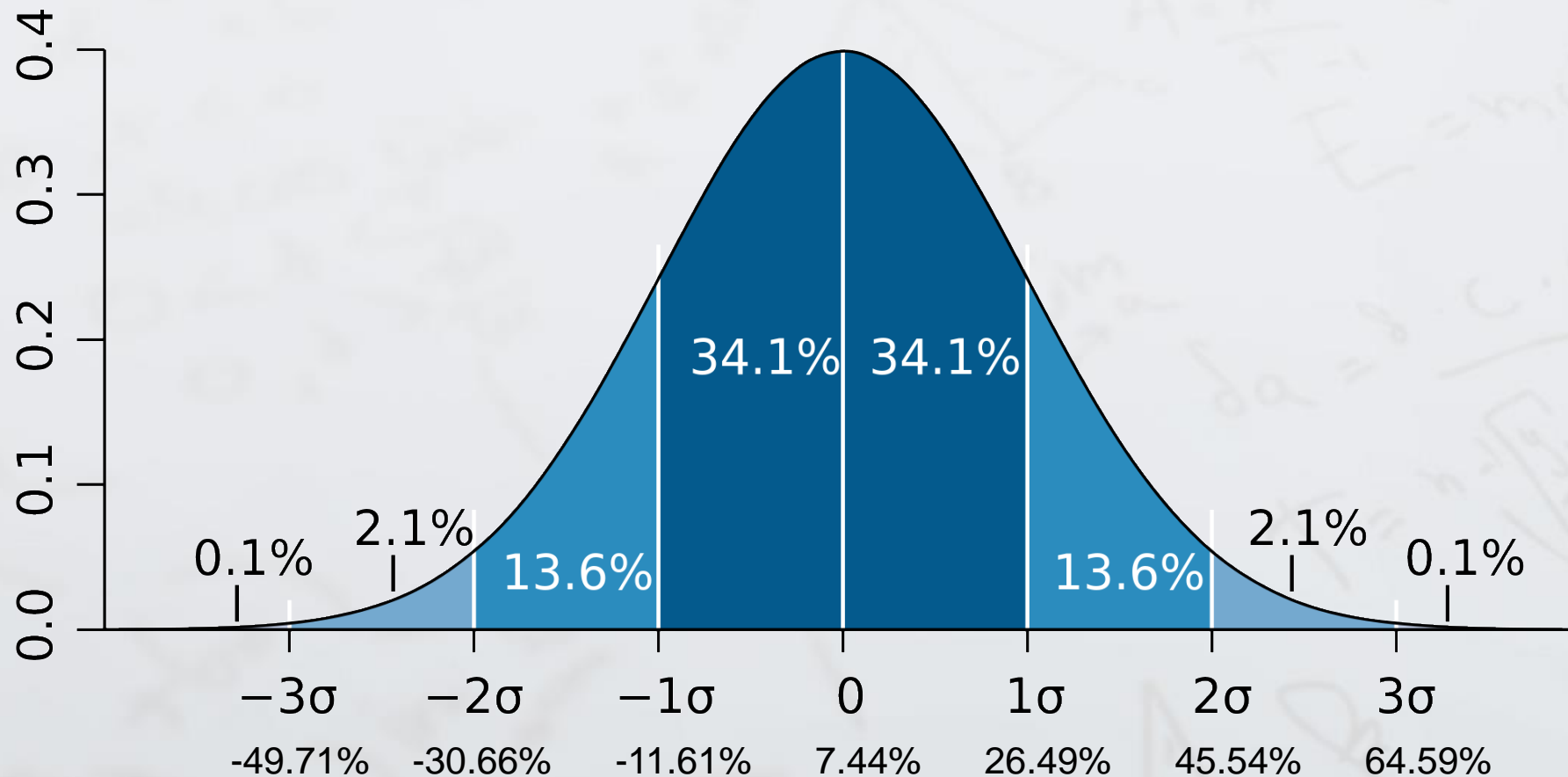
$$A = \frac{1}{N} * \sum_{i=1}^n x_i = 7.44\%$$

Standard Deviation or Risk

$$\sigma = \sqrt{\frac{1}{N} \sum_{i=1}^n [(x_i - \mu)^2]} = 19.05\%$$

THE FAMOUS (or infamous) BELL CURVE

The probability that the Russell 1000 index will yield a certain return in a future year is shown below.



HOW DOES THIS LOOK?

With the help of random number generation, we can project probable future returns.

Trial 1

2016	2017	2018	2019	2020	2021	2022	2023	2024	2025
-25.2%	17.3%	33.7%	28.6%	25.9%	-2.7%	6.8%	32.4%	-5.6%	-2.2%

Trial 2

2016	2017	2018	2019	2020	2021	2022	2023	2024	2025
-1.7%	13.8%	-9.7%	18.2%	-3.9%	2.8%	-27.4%	14.9%	-2.6%	4.14%

Trial 3

2016	2017	2018	2019	2020	2021	2022	2023	2024	2025
3.2%	-14.6%	-43.1%	-7.1%	-11.6%	2.1%	30.5%	0.5%	35.8%	13.8%

FACTOR IN CASH FLOWS WITH MARKET VOLATILITY

Trial 1

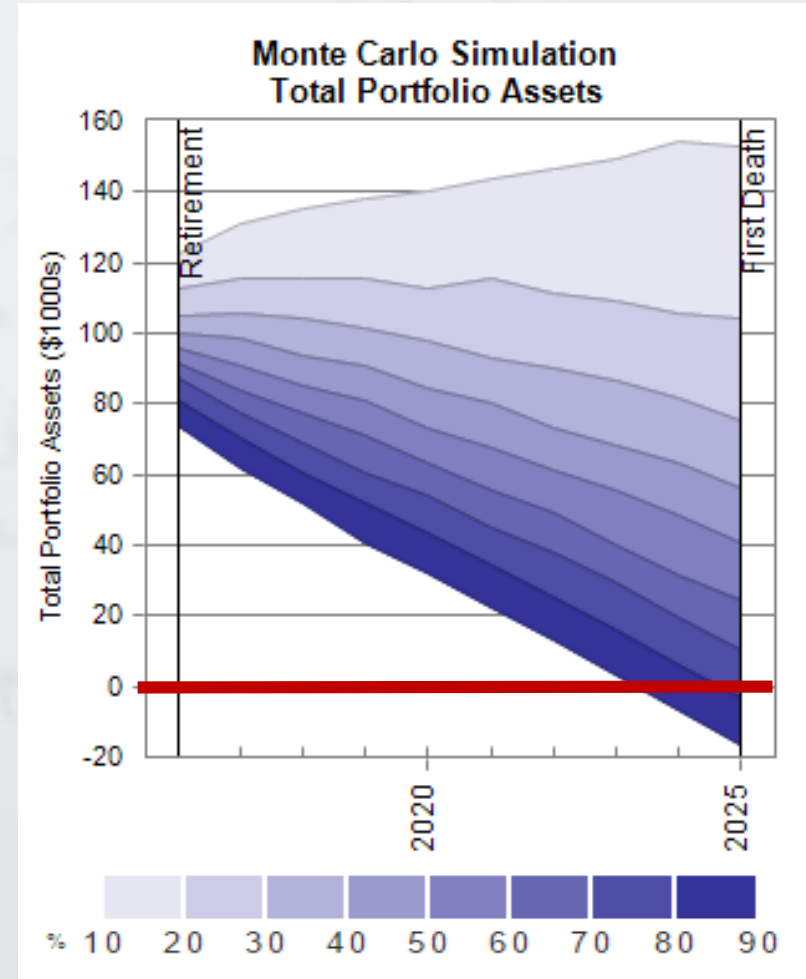
2016	2017	2018	2019	2020	2021	2022	2023	2024	2025
0.0020	-0.0189	0.0882	0.2694	0.0023	-0.3568	-0.1435	-0.1836	0.0078	-0.0431
\$100,196.10	\$88,488.82	\$85,411.12	\$95,726.02	\$85,923.03	\$48,834.46	\$33,261.84	\$18,990.38	\$ 9,060.74	\$ (898.77)
\$10,000.00	\$10,000.00	\$10,000.00	\$10,000.00	\$10,000.00	\$10,000.00	\$10,000.00	\$10,000.00	\$10,000.00	\$10,000.00
\$90,196.10	\$78,488.82	\$75,411.12	\$85,726.02	\$75,923.03	\$38,834.46	\$23,261.84	\$8,990.38	\$ (939.26)	\$ (10,898.77)

Trial 2

2016	2017	2018	2019	2020	2021	2022	2023	2024	2025
0.1601	0.0671	-0.0511	0.2989	-0.0508	0.0682	0.2827	0.0966	0.3367	-0.0084
\$116,012.44	\$113,121.38	\$97,847.10	\$114,105.78	\$ 98,818.83	\$94,876.44	\$108,873.47	\$108,426.20	\$131,564.02	\$120,539.26
\$10,000.00	\$10,000.00	\$10,000.00	\$10,000.00	\$10,000.00	\$10,000.00	\$10,000.00	\$10,000.00	\$10,000.00	\$10,000.00
\$106,012.44	\$103,121.38	\$87,847.10	\$104,105.78	\$88,818.83	\$84,876.44	\$98,873.47	\$98,426.20	\$121,564.02	\$110,539.26

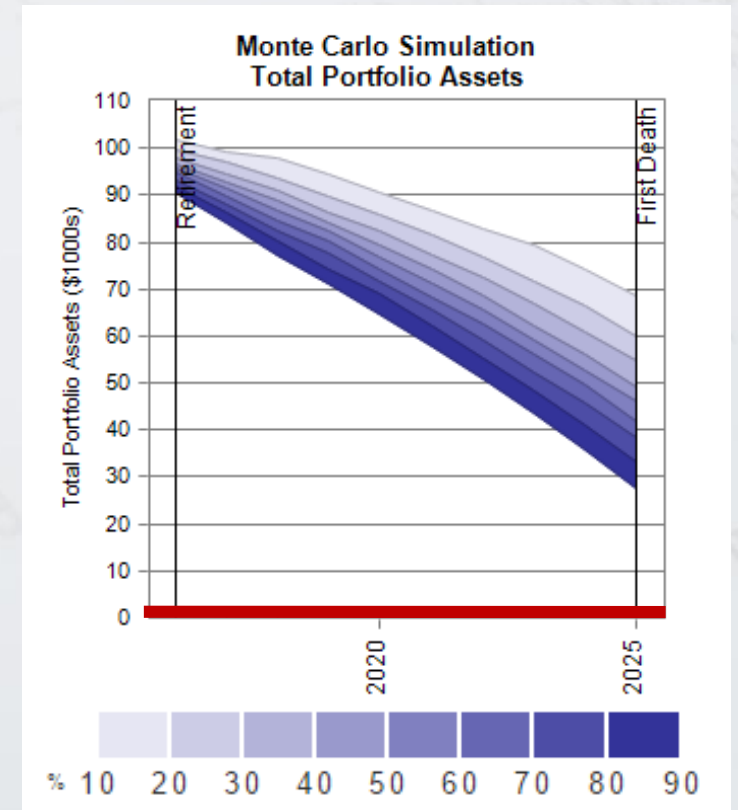
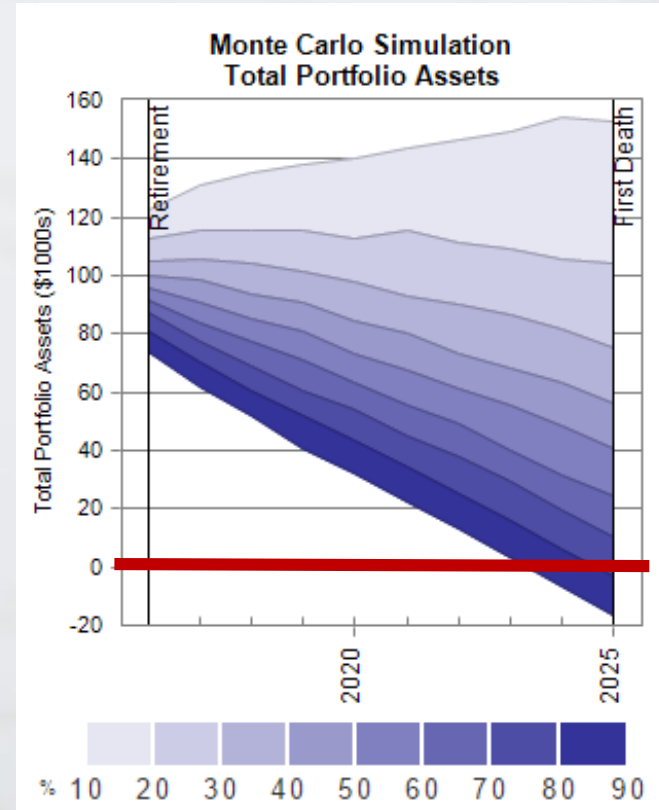
WILL THE MONEY LAST 10 YEARS???

- Answer: **Maybe.**
- After running many trials, we have a probability distribution from which we can derive the **likelihood** that the money will last **10 years**
- By analyzing the distribution of the trials we can say that there is about an **80% chance the money will last.**



THE VALUE OF A DIVERSIFIED PORTFOLIO

By switching from a **100% equity portfolio**, to a diversified income oriented portfolio **(70% bond/ 30% equity)** we limit both our upside and our downside potential.



HOW DOES THIS HELP ANSWER TOUGH QUESTIONS?

In financial planning, the answer is *rarely* yes or no.

- **What happens if the markets take a turn?**
 - “I’ve considered a range of all possible market returns in my analysis of your plan (including a repeat of 2008 and worse) and you have a ____% chance of meeting your goals.
- **When can I retire?**
 - “If you retire in 5 years, you have a ____% chance of meeting your goals, but if you wait 2 years longer, you increase your chance to ____%.”
- **How much can I spend in retirement?**
 - “If you keep up your current spending levels, you only have a ____% chance, but if you spend \$5,000 less per year, you can increase that to ____%.”

Q & A