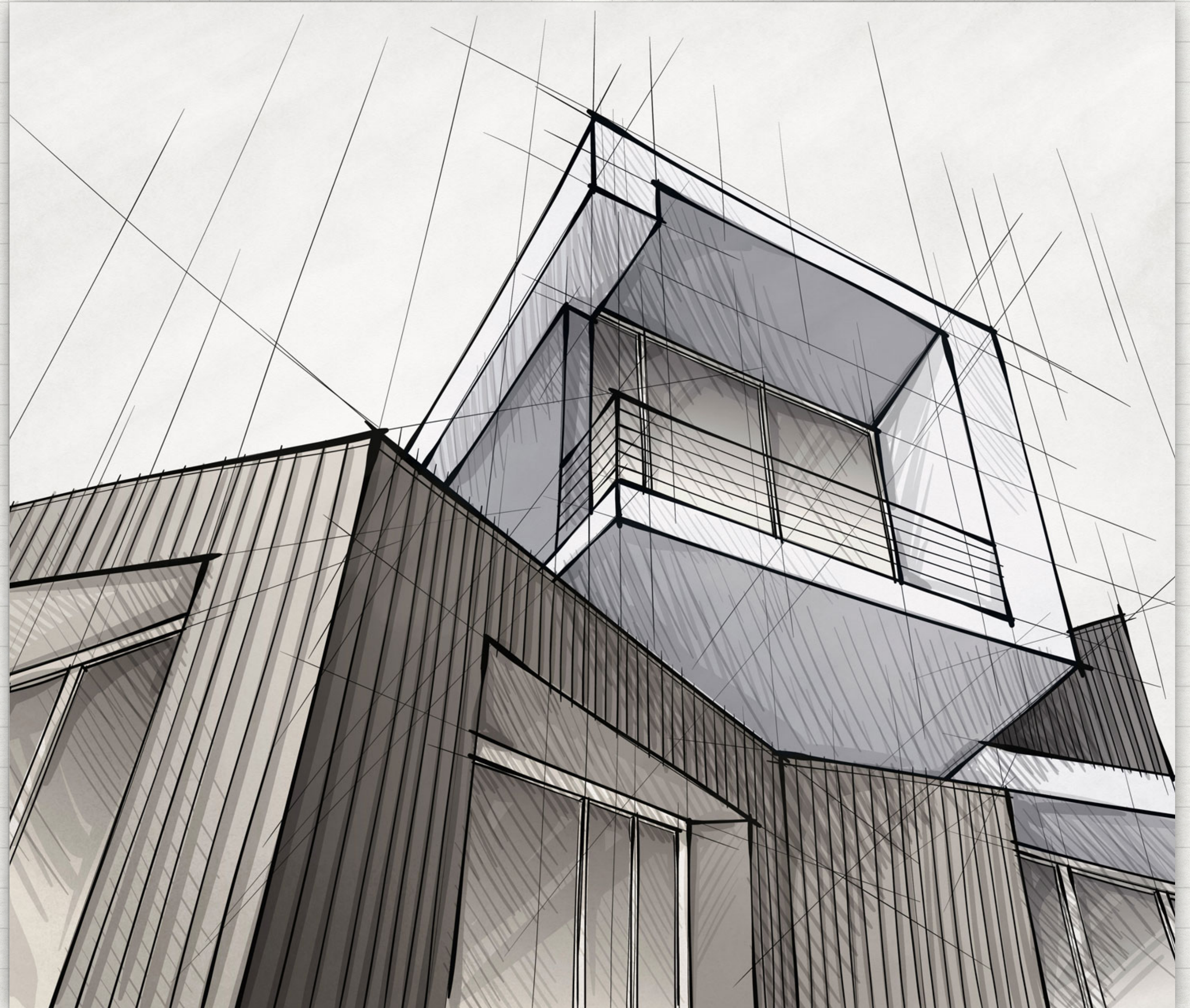


CS 007: SESSION 10

# PERSONAL FINANCE FOR ENGINEERS





CS 007

# ADDITIONAL TOPICS





# SURVEY RESULTS

- Lot of agreement in the free-form entries on survey.
- A few outliers
  - Taxes
  - Alternative Investments
  - Non-Compete Agreements
  - Family Foundations
- The survey confirms:  
**VC/PE, Derivatives, Crypto**

✓ 3

Do you want to cover any of the following topics on December 5th?

44 out of 44 people answered this question (with multiple choice)

Private Equity / Venture Capital

32 resp. 72.7%



Derivatives (Options)

26 resp. 59.1%



Bitcoin / Ethereum / Cryptocurrencies

23 resp. 52.3%



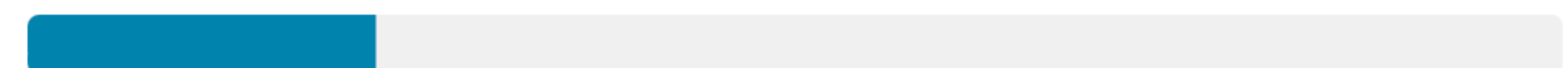
Real Estate as an Investment

20 resp. 45.5%



Charitable Giving & Donor Advised Funds

10 resp. 22.7%





# VENTURE CAPITAL & PRIVATE EQUITY

what are they, why do they exist



# WHAT IS PRIVATE EQUITY?

- Private equity (PE) is composed of funds & investors that are not publicly traded that **invest directly in private companies or buyout public companies.**
- Technically includes venture capital, but commonly refers to funds that **invest in established companies.**
- Focus is on **long term, illiquid investments.**
- Funds can be used to buy out former investors, fund new development, make acquisitions, expand working capital, establish control to change management and company structure.
- A **private equity** firm typically has multiple funds that can vary in size and approach.
- Funds are structured as partnerships with **general partners** that make investment decisions, and **limited partners** who provide capital.





# WHAT IS VENTURE CAPITAL?

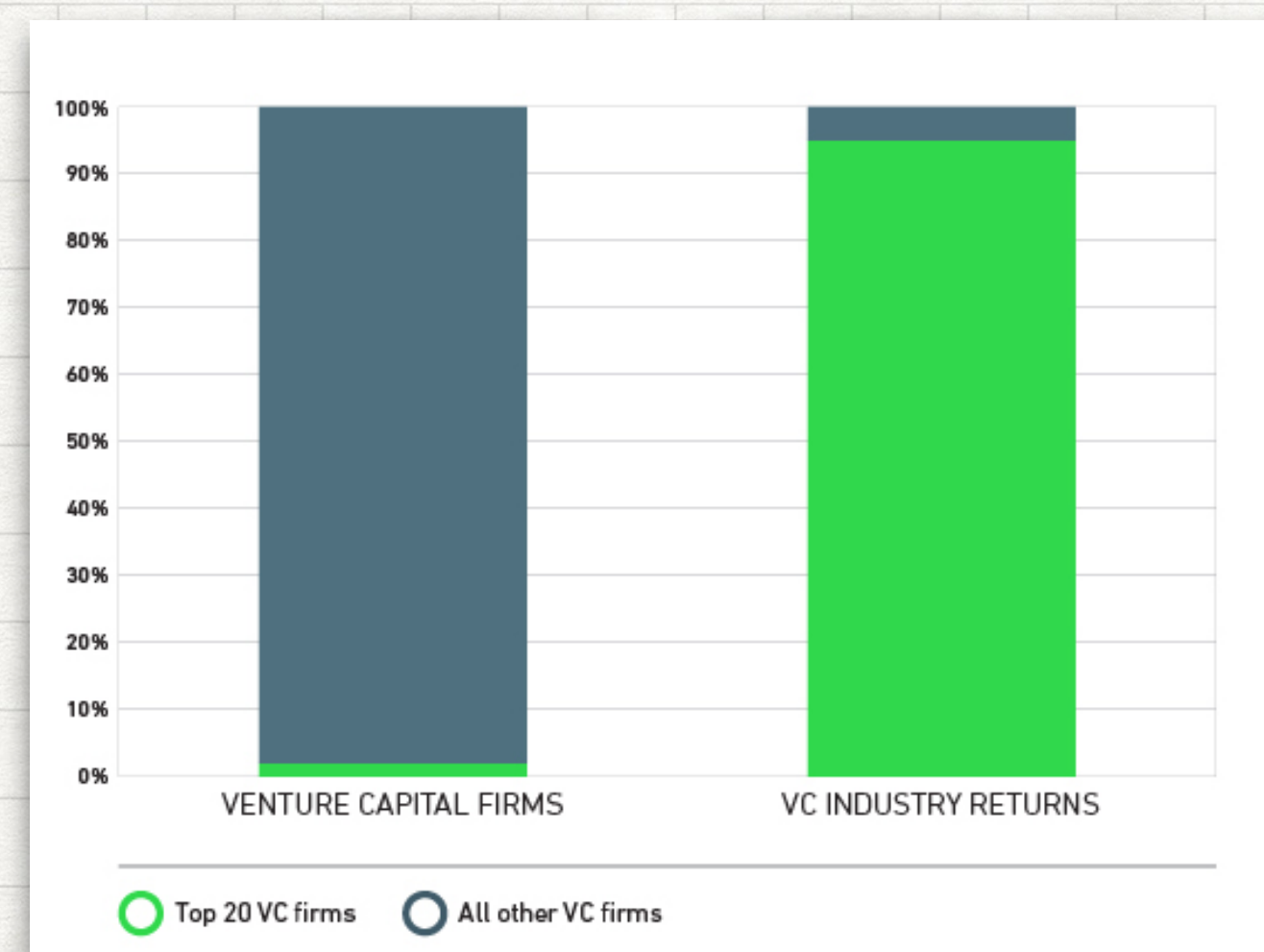
- Venture capital (VC) is a type of private equity focused on financing small, early-stage, emerging companies with high growth potential.
- Companies are funded in a phased model where more capital is provided as the company executes, eliminating risk and increasing value.
- Originated with wealthy families in the first half of the 20th century.
- Closely associated with the exponential growth of technology companies in Silicon Valley in the 1970s & 80s. Early successes include **Digital Equipment Corporation, Apple Computer & Genentech.**
- ERISA changes in 1978 opened the door for pension funds to invest in venture capital. Industry went from \$750M in 1978 to \$31B by end of the 1980s.



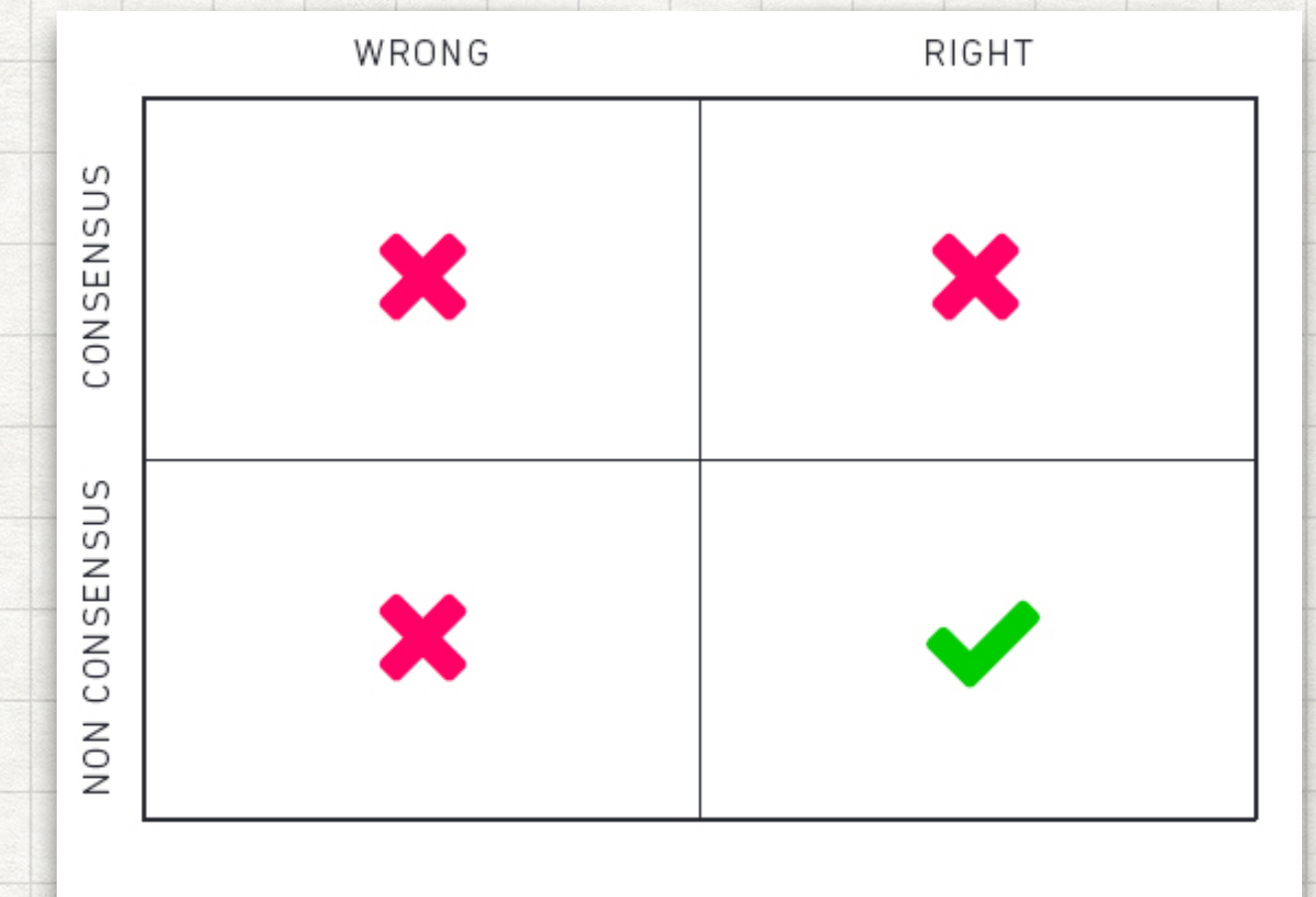


# HOW DO VENTURE CAPITALISTS MAKE MONEY?

- Rounds are typically referred to as pre-seed, seed, A, B, C, etc. They receive a special class of shares called "**preferred**" that have extra rights & privileges, but cost more than "**common**"
- Venture capital firms typically receive capital back only in the case of a **liquidity event**, an IPO or an acquisition.
- It can take anywhere from 5-7 years for a venture investment to become liquid.
- Top 20 VC firms (out of approximately 1000) generate about 95% of the industry's returns.
- Limited partners typically expect a significant premium over the stock market to compensate for the additional risk & illiquidity of venture capital.
- 80% of a typical venture capital fund returns are generated by 20% of the investments (William Sahlman).
- As a result, winners have to be very large to return the fund, let alone a venture-class compounded return. A company worth \$1B is a very successful company, but 20% of that company is only worth \$200M. To just return a \$1B fund, you'd need 5 of those. To return 3x the fund, you'd need 15.
- To find investments that 10x your money, you have to be **non-consensus** and **right**. (Howard Marks)



VC Firm Returns



Howard Marks 2x2 Matrix

*Biggest problem? You can't get your money into the Top 20 firms.*



# DERIVATIVES

futures & options



# WHAT IS A DERIVATIVE?

- A **derivative** is a security that is dependent upon one or more underlying assets.
- A derivative can be created by a unique contract or standardized for trading on exchanges.
- The most common standardized derivatives are: **futures & options**
- They are often used for **hedging** or **speculation**.
- The overall notional value for derivatives was estimated at **\$1.2 Quadrillion** in 2015, more than 10x the size of global GDP.



Derivatives are financial weapons of mass destruction.

— *Warren Buffett* —

AZ QUOTES



# WHAT IS A FUTURE?

- A future is a **contract for the future sale** of a commodity at a pre-determined time & price.
- Original use cases included **farming & shipping**.
- First exchange in feudal Japan, **Dojima Rice Exchange**.
- Futures are settled by delivery of the underlying goods, on the date and at the time specified.
- **Clearinghouses** ensure that contract payments are fulfilled.





# WHAT IS AN OPTION?

- An option is the right to either buy or sell a security by a future date.
- European options can only be exercised on the expiration date.
- American options can be exercised anytime up to the expiration date.
- A call option is the right to buy
- A put option is the right to sell



3	33	33,33	33,33	33,33	17,19	-0,06	-0,14%
1	11	11,11	11,11	11,11	17,12	+0,56	1,91%
1	11	11,11	11,11	11,11	42,14	+0,17	3,52%
1	11	11,11	11,11	11,11	27,07	+0,26	0,89%
1	11	11,11	11,11	11,11	21,18	-1,14	-4,08%
1	11	11,11	11,11	11,11	27,33	+13,53	3,32%
1	11	11,11	11,11	11,11	311,58	+0,82	0,54%
1	11	11,11	11,11	11,11	96,51	+0,41	1,62%
1	11	11,11	11,11	11,11	25,32	+0,28	1,33%
1	11	11,11	11,11	11,11	29,81		
1	11	11,11	11,11	11,11	31,47		



# HOW DO YOU VALUE AN OPTION?

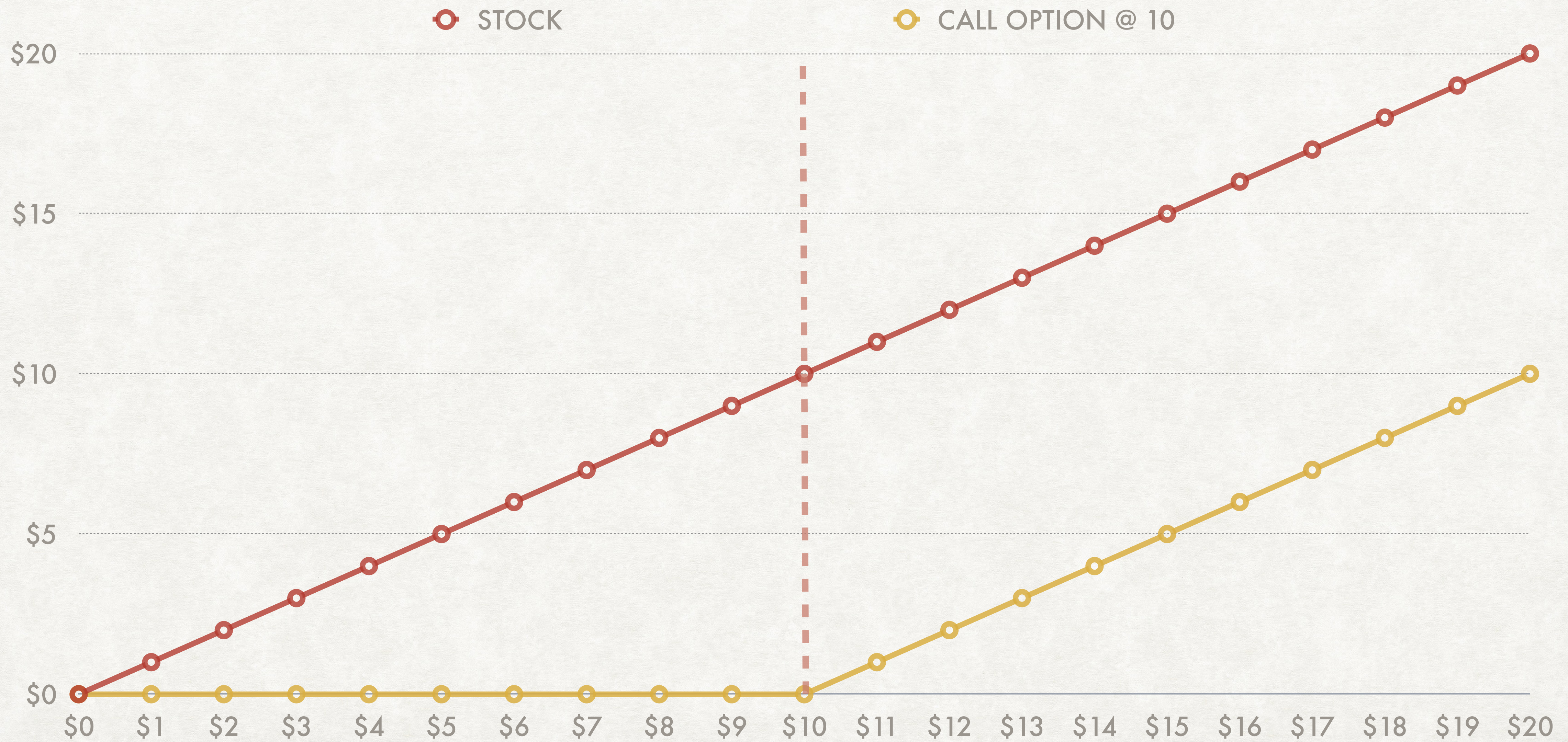
- There are multiple factors that affect the value of a stock option.
  - Current stock price
  - Intrinsic value
  - Time to expiration
  - Volatility
  - Interest rates
  - Cash dividends
- **Black-Scholes** was developed in 1973 by Fischer Black, Robert Merton & Myron Scholes.
- “**Fair Value**” often refers to the Black-Scholes value for a derivative, although there are other methods to calculate the value of a derivative.
- The price of an option is called the **premium**, and is quoted as a per share price even though options trade in blocks of 100.



$$\frac{\partial V}{\partial t} + \frac{1}{2}\sigma^2 S^2 \frac{\partial^2 V}{\partial S^2} + rS \frac{\partial V}{\partial S} - rV = 0$$



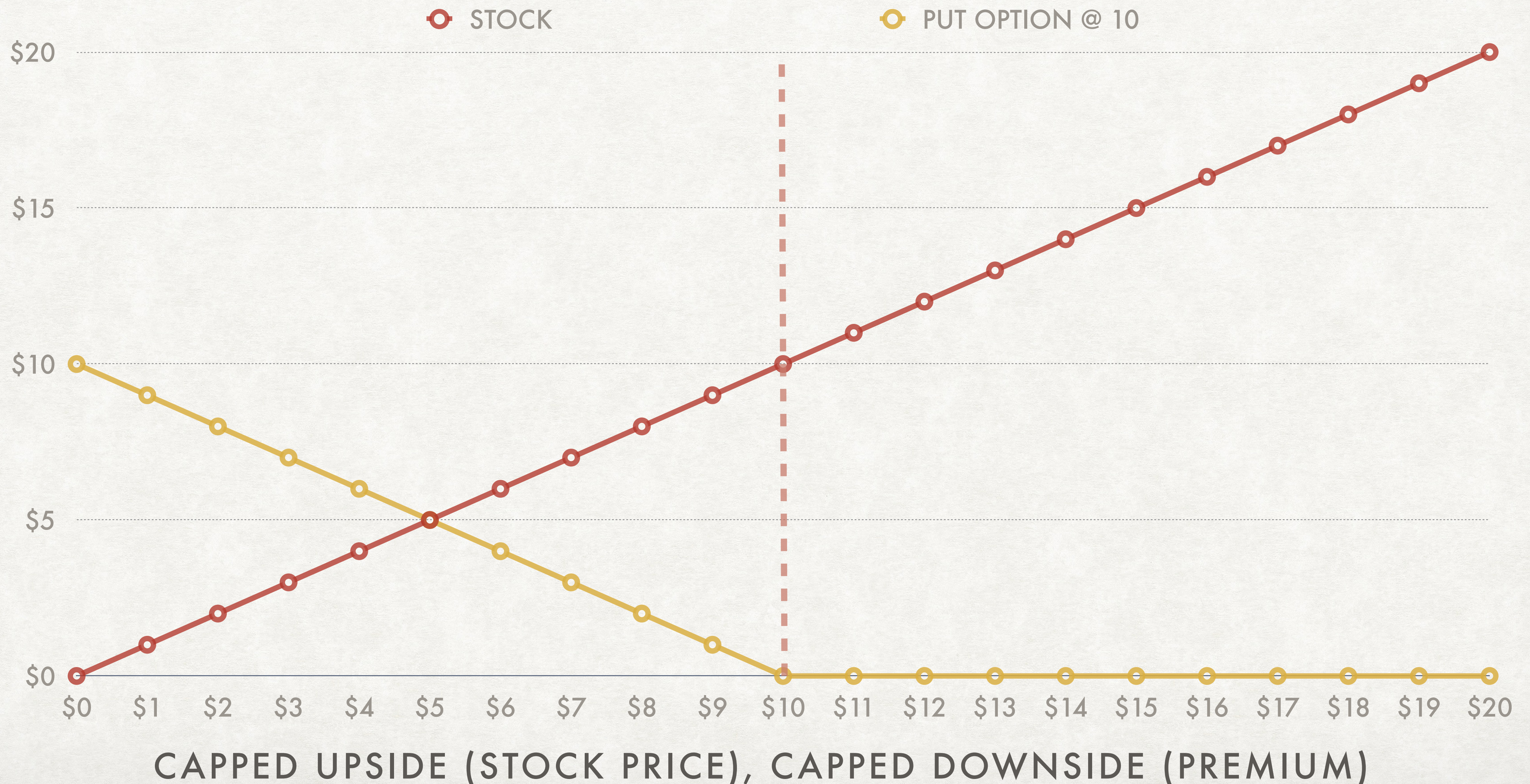
# EXAMPLE: BUYING A CALL OPTION (INTRINSIC VALUE)



UNLIMITED UPSIDE, CAPPED DOWNSIDE (PREMIUM)

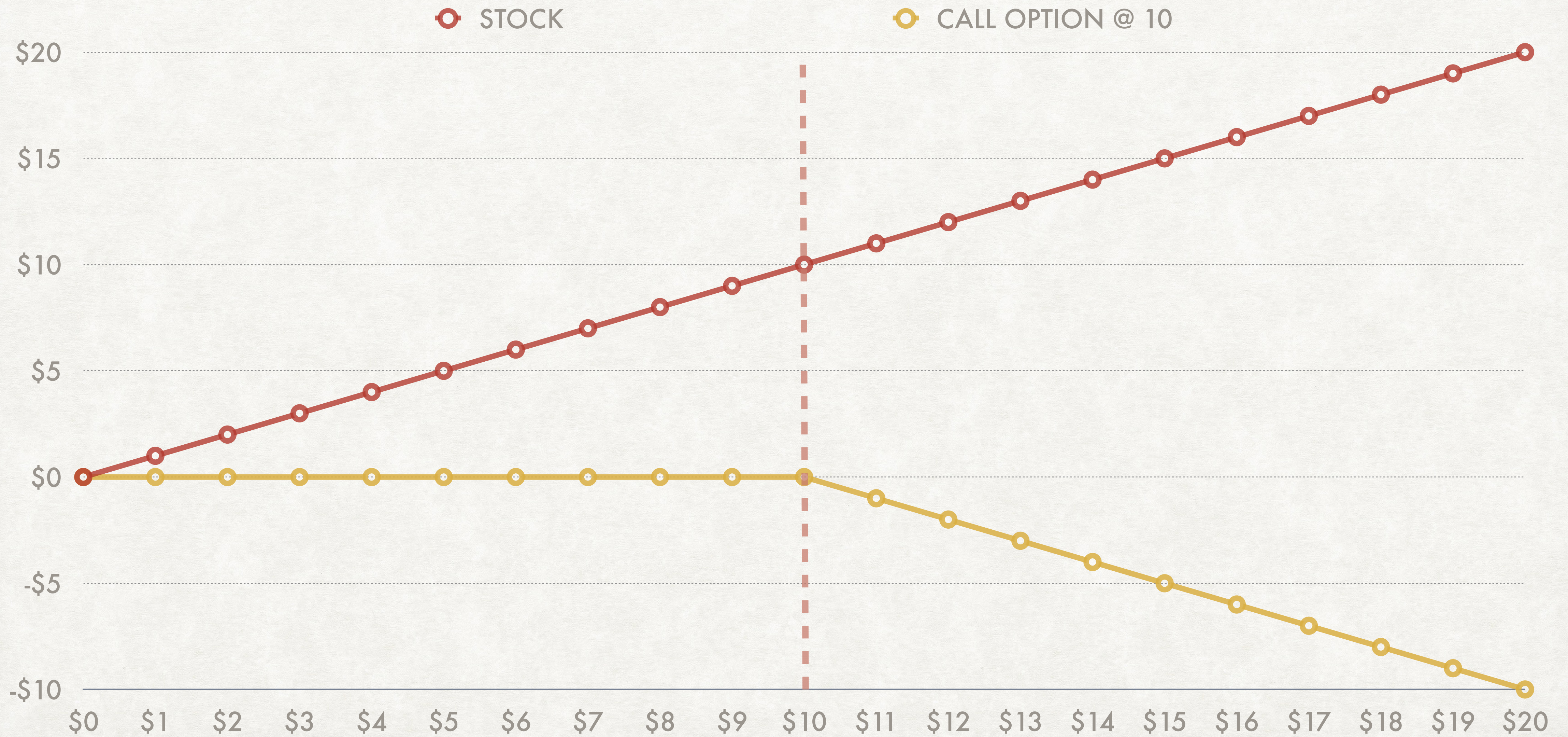


# EXAMPLE: BUYING A PUT OPTION (INTRINSIC VALUE)





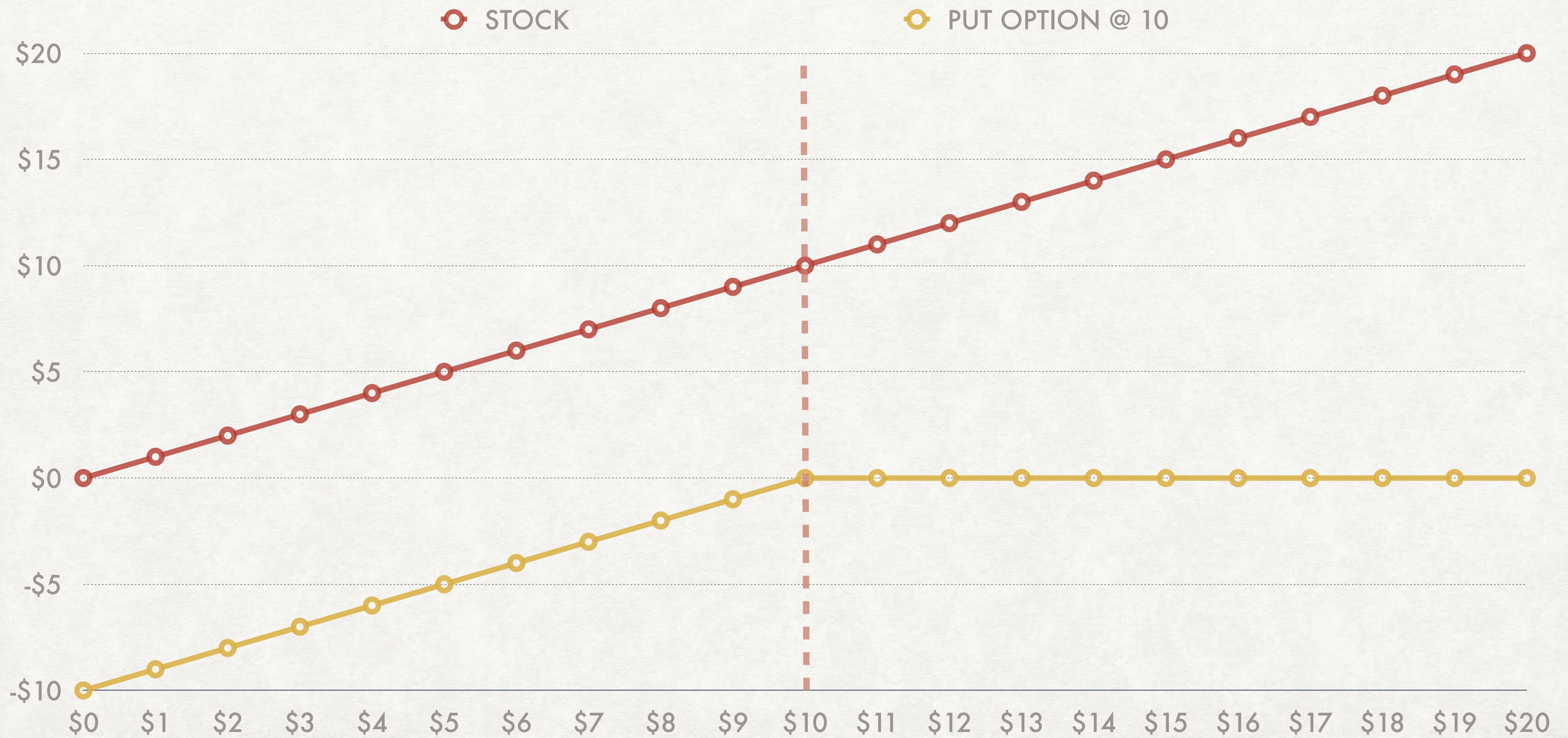
# EXAMPLE: SELLING A CALL OPTION (INTRINSIC VALUE)



CAPPED UPSIDE (PREMIUM), UNLIMITED DOWNSIDE



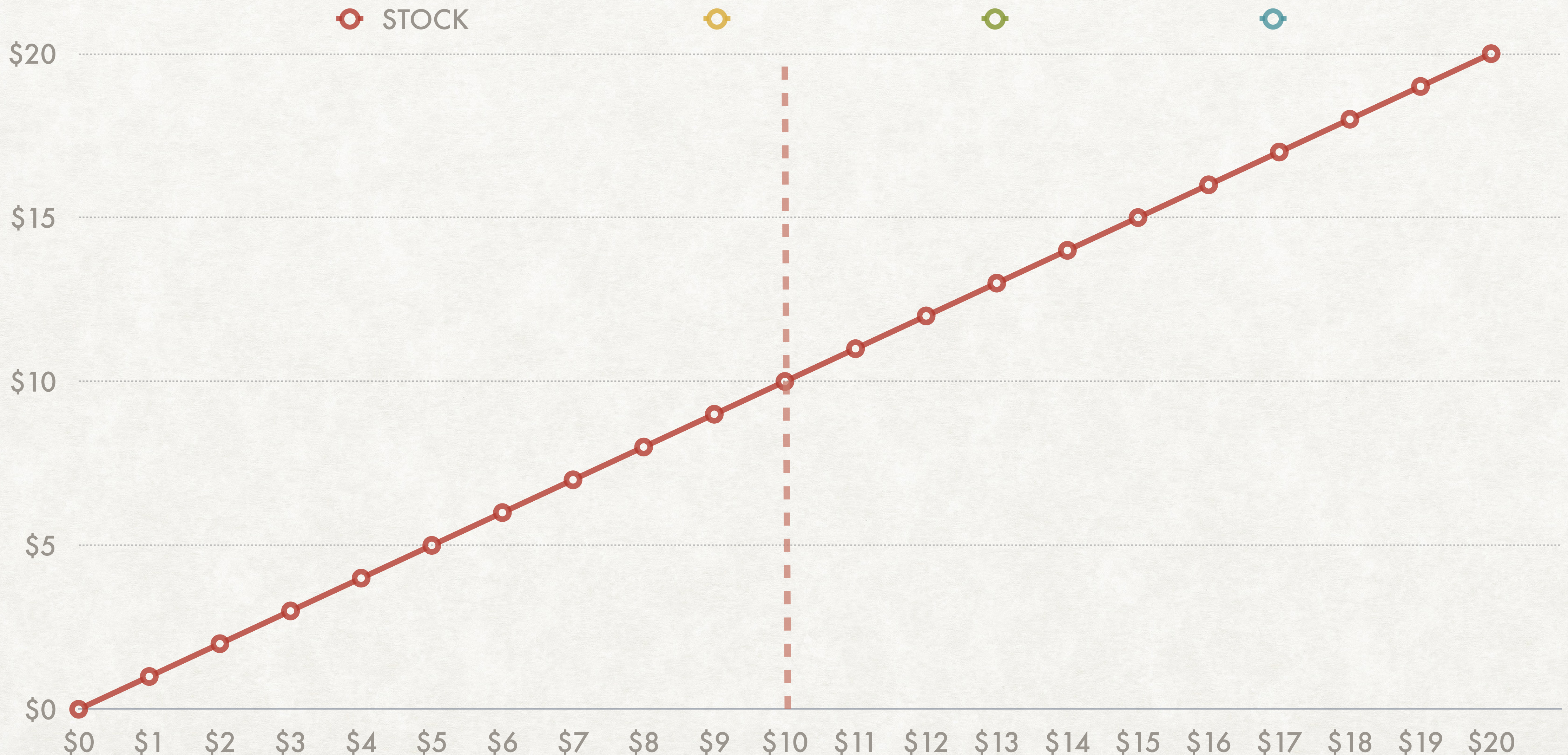
# EXAMPLE: SELLING A PUT OPTION (INTRINSIC VALUE)



CAPPED UPSIDE (PREMIUM), CAPPED DOWNSIDE (STRIKE PRICE)



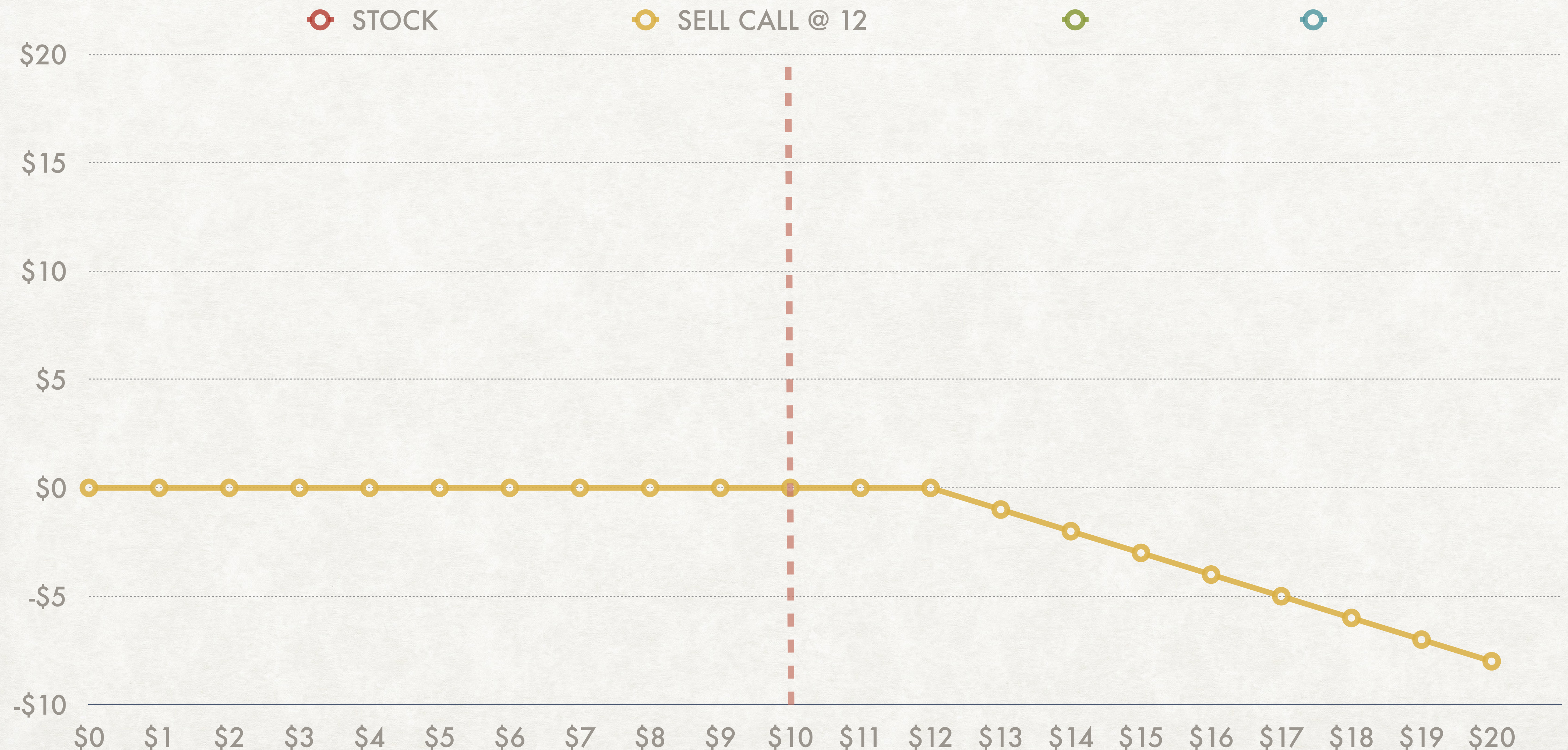
# COMBINATIONS: A ZERO COST COLLAR (INTRINSIC VALUE)



ASSUME YOU HAVE STOCK YOU WANT TO HOLD, BUT PROTECT DOWNSIDE



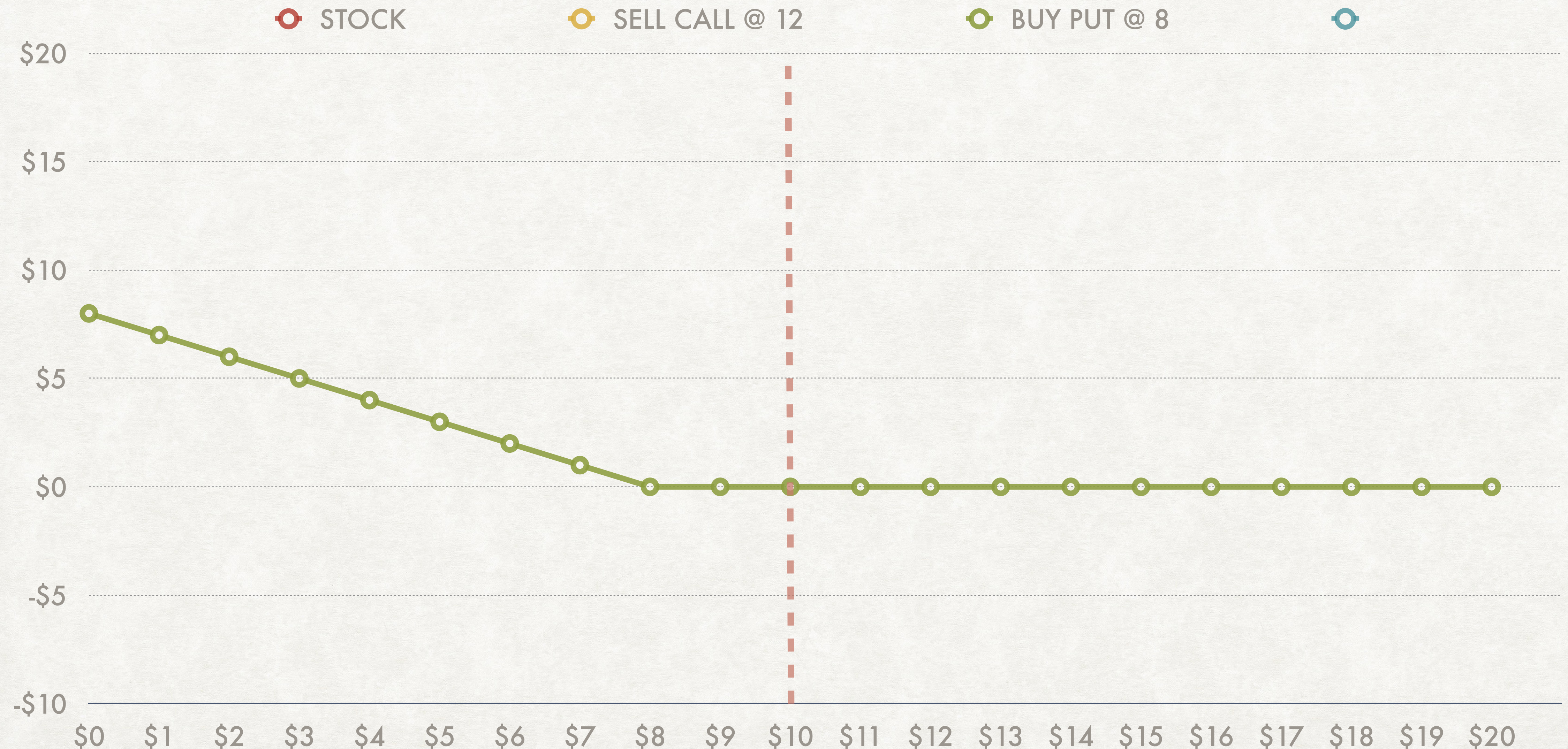
# COMBINATIONS: A ZERO COST COLLAR (INTRINSIC VALUE)



SELLING CALL GIVES YOU CASH TO BUY PUT, BUT LIMITS UPSIDE TO 12



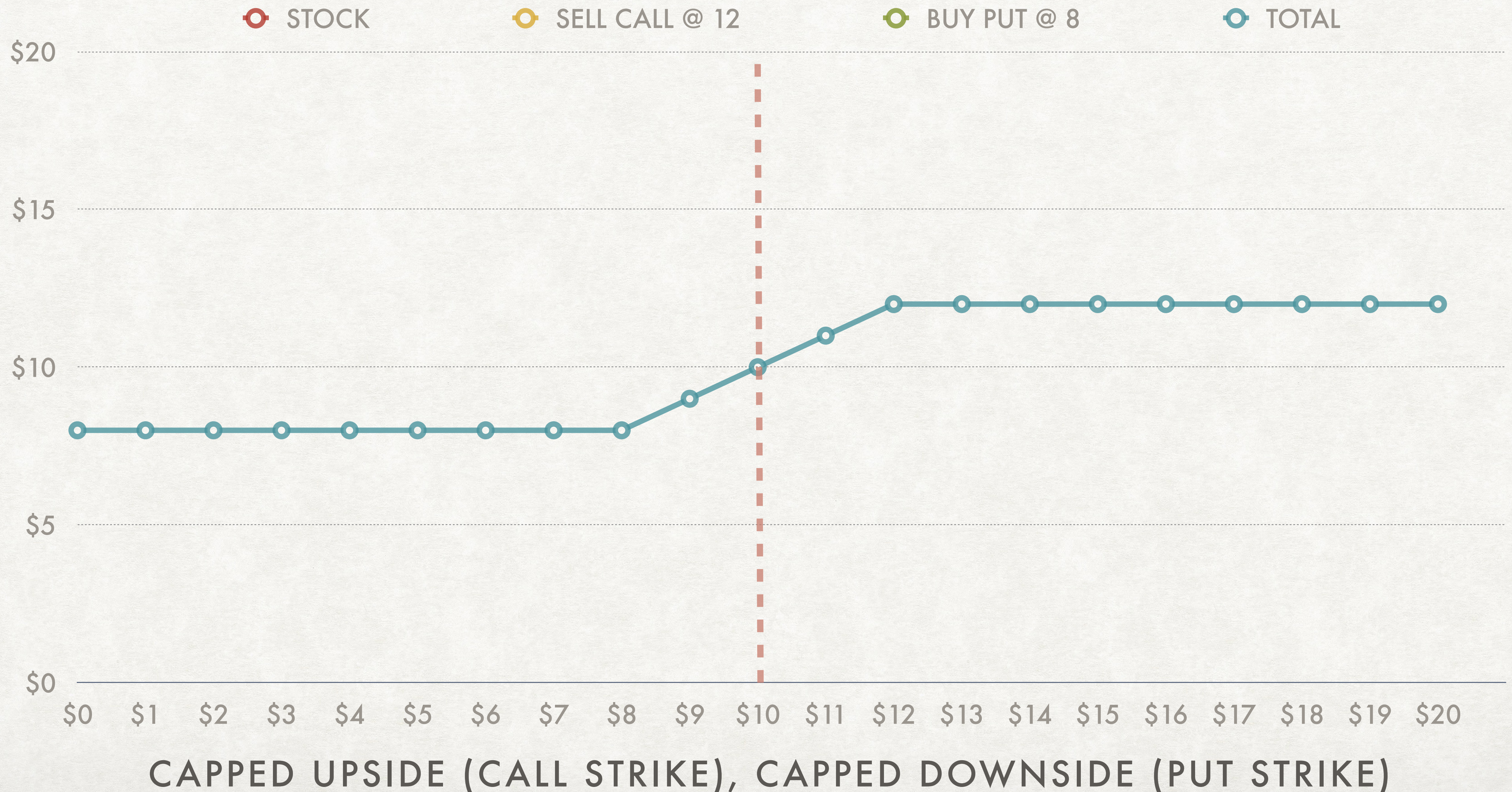
# COMBINATIONS: A ZERO COST COLLAR (INTRINSIC VALUE)



PUT GIVES YOU INSURANCE IF THE STOCK FALLS BELOW 8

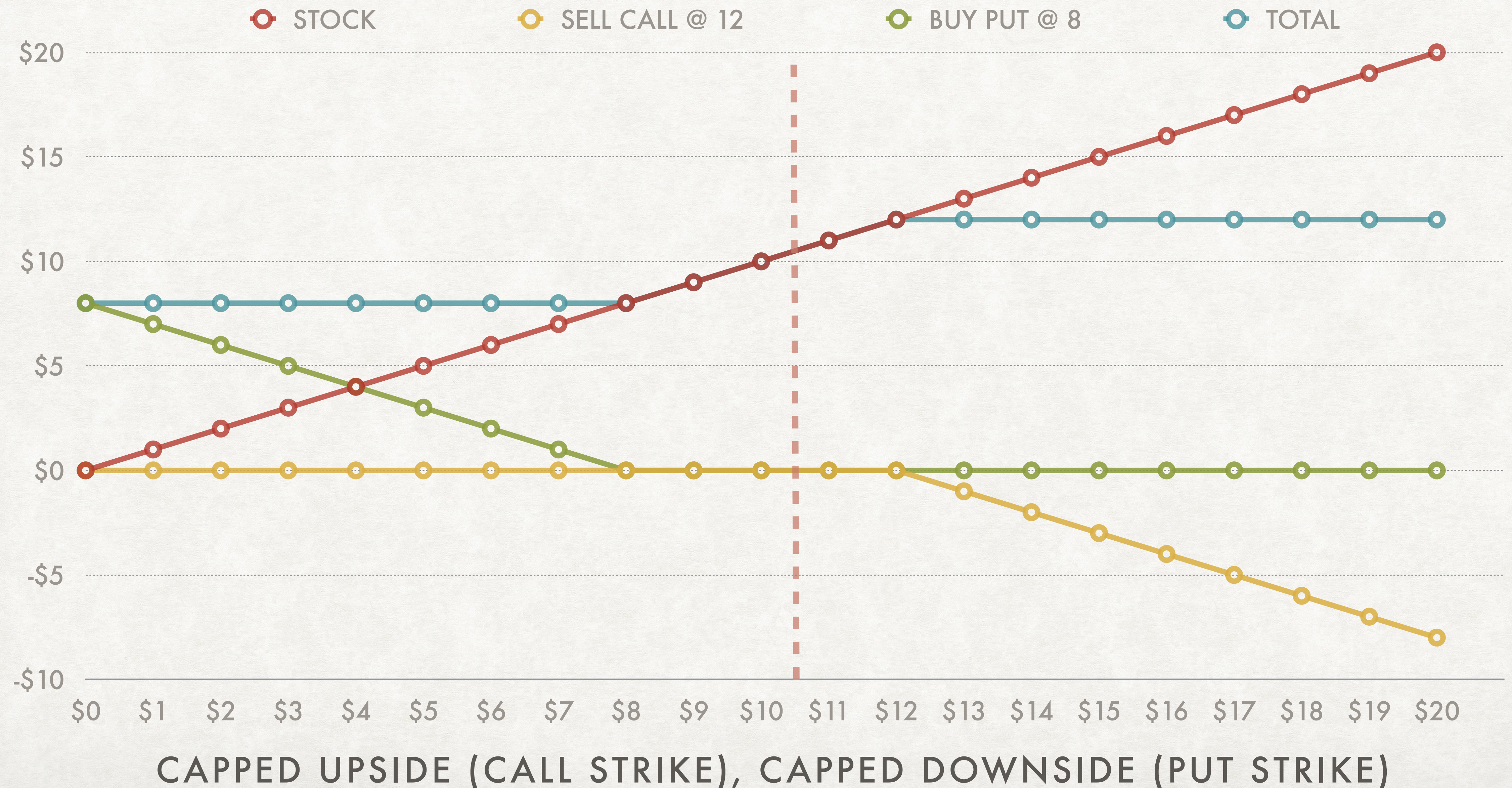


# COMBINATIONS: A ZERO COST COLLAR (INTRINSIC VALUE)





# COMBINATIONS: A ZERO COST COLLAR (INTRINSIC VALUE)





# CRYPTO

basics & common questions



# WHAT IS BITCOIN?

- **Bitcoin** is a **cryptocurrency**, a digital asset designed to work as a medium of exchange.
- Paper by **Satoshi Nakamoto** (who is unknown) published on 10/31/2008, *"A System for Electronic Transactions Without Relying on Trust"*
- Network went live in January 2009 with first open source client & bitcoins. Satoshi mined the first block ever ("the genesis block")
- **Blockchain** is a cryptographically secure, distributed ledger for transactions.
- Fixed supply, constrained to 21M total possible. **Scarcity is designed into the system.**
- Bitcoin are issued as rewards for "mining", which is the process of adding compute to the network.





# WHY IS BITCOIN INTERESTING?

- Publicly transparent & uncensored distributed ledger for financial transactions.
- A digital asset that cannot be freely copied, with enforced scarcity.
- A “digital store of value”
- **Byzantine Generals’ Problem**  
Original paper describing from 1982\*  
Satoshi explanation from 2008\*\*
- Cryptographically secure.
- Network with the highest value (as measured by coin-based market capitalization)



\* <https://www.microsoft.com/en-us/research/publication/byzantine-generals-problem/>

\*\* <https://www.mail-archive.com/cryptography@metzdowd.com/msg09997.html>



# WHAT IS ETHEREUM?

- Ethereum is a decentralized platform that runs smart contracts.
- Blockchain-based distributed computing.
- Launched 2014.
- Ether is the digital asset.
- Ethereum transaction fees are based on computational power required.
- Supply of Ether not limited. Built in inflation of 18m (max) per year.
- Transition to Ethereum 2.0



## The Beacon Chain

The first Eth2 addition to the ecosystem. The Beacon Chain will coordinate the new system, bring staking to Ethereum and lay the groundwork for future upgrades.

December 1, 2020

[More on the Beacon Chain](#)



## Shard chains

Shard chains will expand Ethereum's capacity to process transactions and store data. The shards themselves will gain more features over time, rolled out in multiple phases.

Estimate: 2021

[More on the shard chains](#)



## The docking

Mainnet Ethereum will need to "dock" or "merge" with the beacon chain at some point. This will enable staking for the entire network and signal the end of energy-intensive mining.

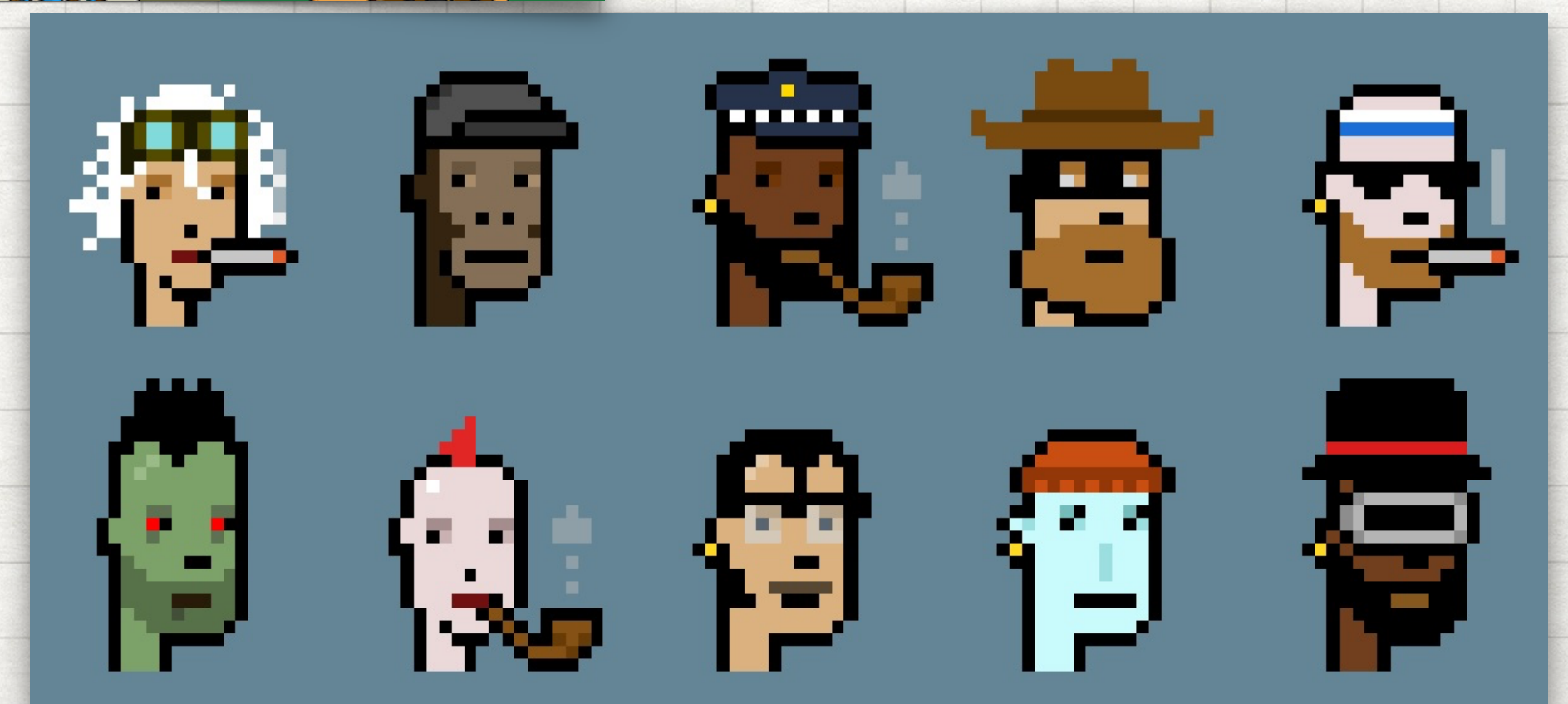
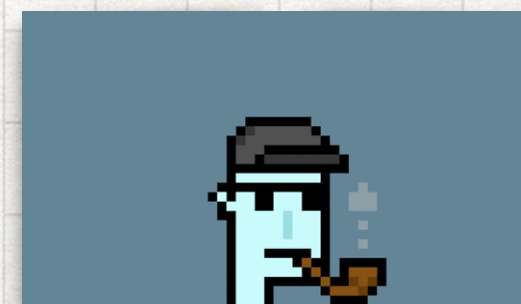
Estimate: 2022

[More on the docking](#)



# WHAT ARE NFTS?

- NFTs (or “non-fungible tokens”) are a special kind of cryptoasset in which each token is unique.
- Can be used to authenticate ownership of digital assets like artworks, recordings, and virtual real estate or pets.
- Most non-fungible tokens are built using the ERC-721 and ERC-1155 standards.
- Accessible via wallets (Coinbase, Rainbow, Metamask) & marketplaces (OpenSea)
- In 2017, Cryptopunk #7804 sold for \$15,000. In 2021, Dylan Field sold it for 4200 ETH (~\$7.5M)
- Total sales of \$3.4B in Aug 2021
- NFT trading volume has dropped 97% in 2022, from over \$17B to \$466M in September.\*



\* <https://www.bloomberg.com/news/articles/2022-09-28/nft-volumes-tumble-97-from-2022-highs-as-frenzy-fades-chart>



# HOW MUCH IS BITCOIN WORTH?

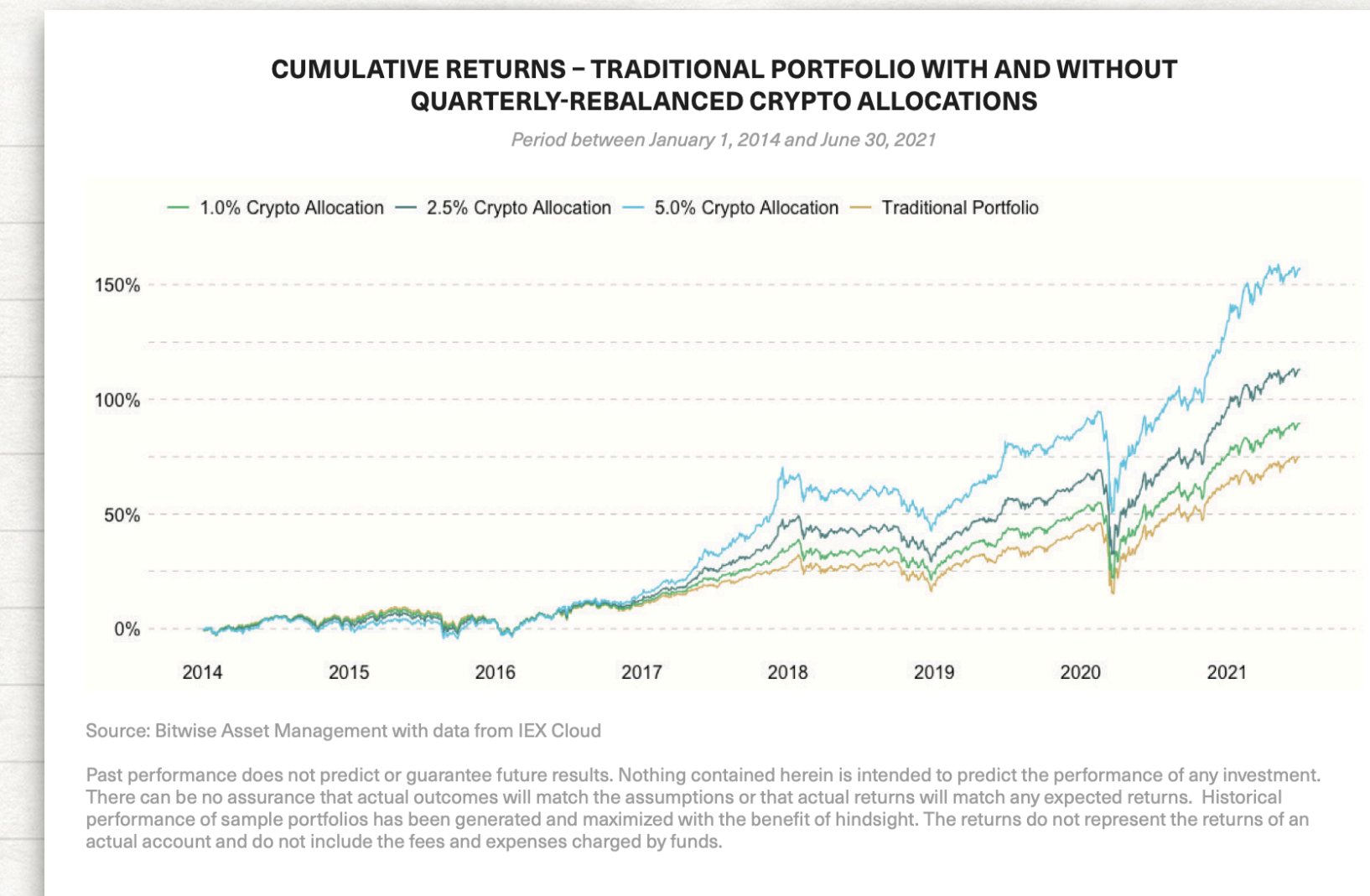
- First bitcoin transaction was on May 22, 2010, purchasing two Papa John's pizzas for 10,000 BTC.
- In five days, price of BTC went from \$0.008 to \$0.08, a gain of 1000%.
- Bitcoin was less than \$1,000 on 1/1/2017
  - Bitcoin was \$11,600 on 12/4/2017
  - Bitcoin was \$3,896 on 12/3/2018
  - Bitcoin was \$7,314 on 12/1/2019
  - Bitcoin was \$17,597 on 11/17/2020
  - Bitcoin was \$50,615 on 12/6/2021
  - Bitcoin was \$17,015 on 12/5/2022
- Is there a fundamental basis for valuing Bitcoin? How do you value an asset that generates no cash flow?





# WHAT WOULD BITCOIN LOOK LIKE IN A DIVERSIFIED PORTFOLIO?

- As of EOY 2020:
  - Global equity markets: \$105T
  - Global bond markets: \$123.5T
- Bitcoin is currently valued at ~\$328B
- Bitwise Investments estimates\*\* the correlation of Bitcoin to only 0.08 with Equities (VTI), 0.02 with Bonds (BND).
- Bitwise Investments\*\*\* has a portfolio simulator that allows you to view how your portfolio would have performed w/ either Bitcoin or the Bitwise 10 Index.
- Increasing possibility that cryptocurrency becomes an asset class, long term.



PORTFOLIO PERFORMANCE METRICS					
Period between January 1, 2014 and June 30, 2021 (assuming quarterly rebalancing)					
PORTFOLIO	CUMULATIVE RETURN	ANNUALIZED RETURN	ANNUALIZED VOLATILITY	SHARPE RATIO	MAXIMUM DRAWDOWN
Traditional Portfolio	74.72%	7.75%	10.19%	0.609	21.07%
Traditional Portfolio + 1.0% crypto	89.26%	8.90%	10.21%	0.719	21.32%
Traditional Portfolio + 2.5% crypto	112.73%	10.62%	10.43%	0.867	21.80%
Traditional Portfolio + 5.0% crypto	156.46%	13.42%	11.18%	1.055	22.76%

Source: Bitwise Asset Management with data from IEX Cloud

\* <https://www.bitwiseinvestments.com/resources>

\*\* <https://bitwiseinvestments.com/tools/correlations>

\*\*\* <https://s3.amazonaws.com/static.bitwiseinvestments.com/Bitwise-The-Case-For-Crypto-In-An-Institutional-Portfolio.pdf>

\*\*\*\* Please note: this is not an endorsement for Bitwise Investments. Adam Nash is a seed investor & advisor to the company.



CS 007

# QUESTIONS





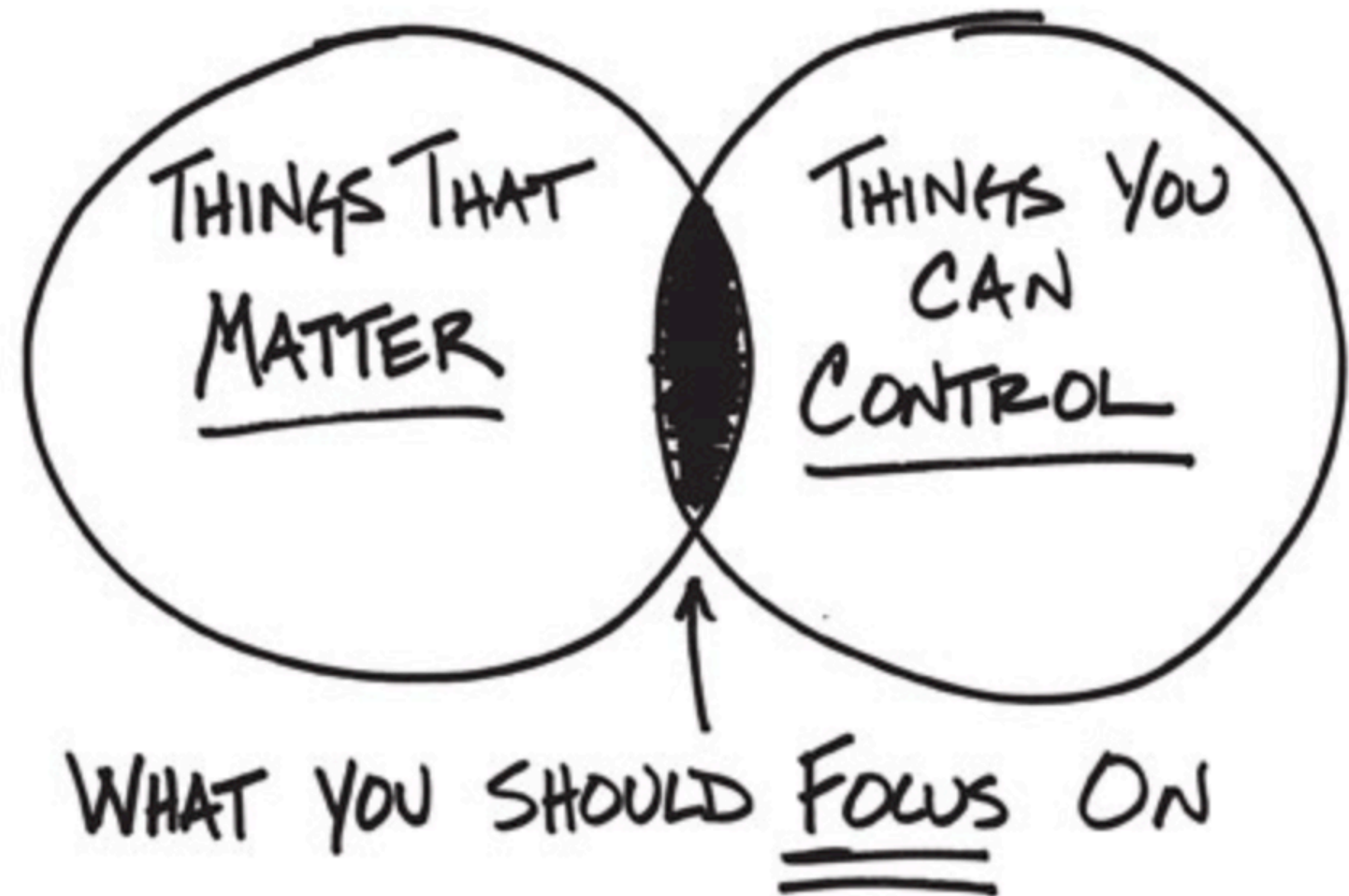
# FINAL THOUGHTS

wrapping up



# FIRST SLIDE: WHY PERSONAL FINANCE?

- Poorly covered in secondary school & university curricula, even at top schools.
- Not technically difficult, but the signal-to-noise ratio is terrible.
- Massive impact on your life.
- Affects everyone.



BEHAVIORGAP.COM



# LAST SLIDE: THINGS TO DO AFTER THIS CLASS

- **Keep thinking actively** about your financial plans and decisions.
- **Discuss personal finance** and related topics with your friends & family.
- Don't be afraid to make decisions, and **learn from your mistakes**. Better to make them when the dollars are small and your responsibilities are few.
- Be skeptical of any quick and easy paths to financial success.
- Always remember: good investing is boring.
- Please join the CS 007 alumni group, a private list for students who have taken this class and want a safe place to discuss personal finance questions.

