DATASCI 385 Quantitative Finance

Lecture 3: Equities

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Suggested reading: Investments Ch 2

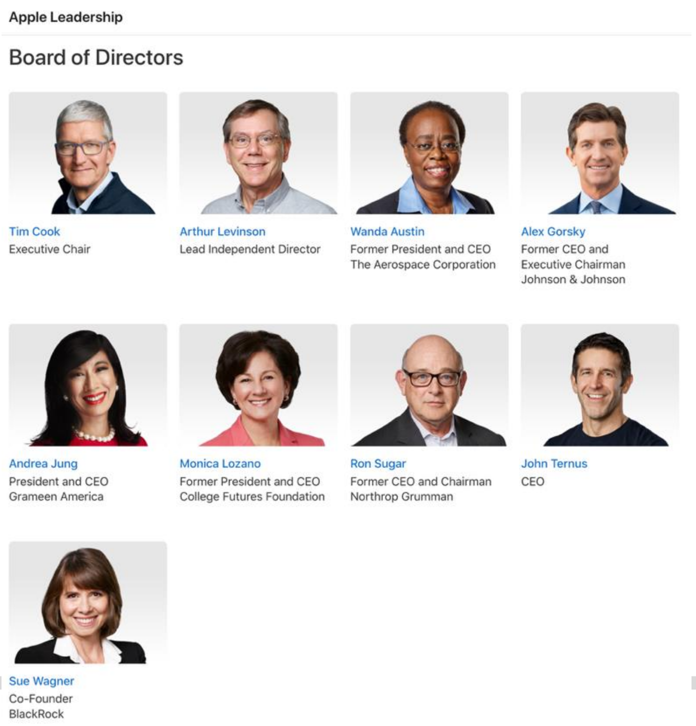
EMORY

Financial markets

- **Financial markets** are segmented into money markets and capital markets
- **Money market**: short-term, marketable, liquid, low-risk debt securities
  - Money market instruments are also called cash equivalents
- **Capital market**: longer term, riskier securities
  - Longer term bond markets
  - Equity markets
  - Derivative markets for options and futures

Equity securities

- *Common stocks*, also known as *equity securities* or **equities**, represent ownership shares in a corporation
- Owner of common stock
  - Vote on any matters of corporate governance (can vote by proxy)
  - Share of the financial benefits of ownership
- Shareholders elect a board of directors
- The board selects managers
  - The board meets a few times a year
  - Managers run the firm on a day-to-day basis



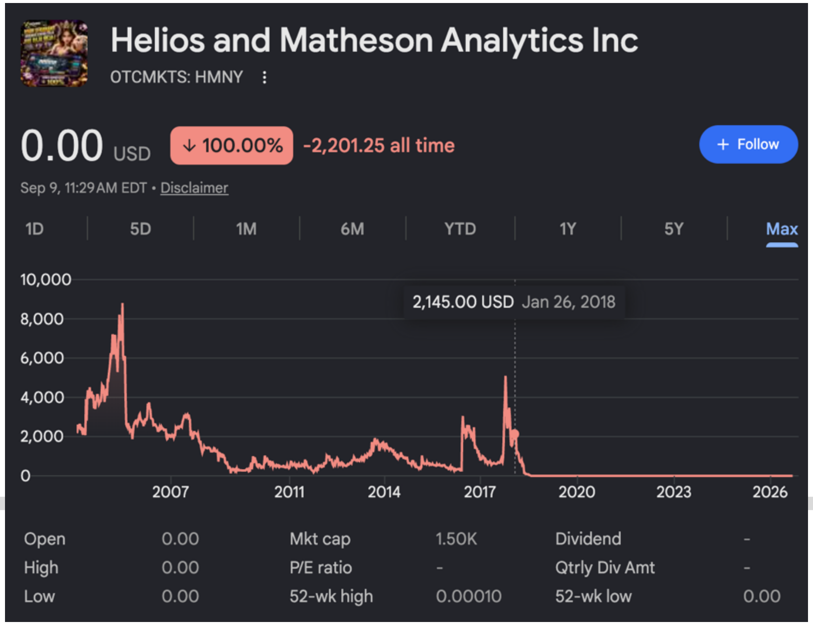
Characteristics of common stock

- Two characteristics of common stock: residual claims and limited liability
- **Residual claim**: Stockholders are the last to claim assets and income
  - In a *liquidation* of the firm's assets, claim what is left after tax authorities, employees, suppliers, bondholders, and other creditors have been paid
  - Not in *liquidation*, claim to the part of *operating income* left over after interest and taxes have been paid (as cash dividends or reinvest to increase the value of shares)

- **Limited liability**: Not personally liable for the firm's obligations
  - Unlike owners of unincorporated businesses (lay claim to personal assets, e.g., house, car)

Example: Helios and Matheson Analytics (HMNY)

- HMNY was a publicly traded data analytics company
- Known as the parent company of MoviePass, gained massive popularity for its $9.95 a month plan for unlimited daily movies in 2017
- HMNY filed Chapter 7 bankruptcy liquidation, sold off remaining assets to pay off its creditors, suppliers and legal liabilities
- Zero residual value left. Shareholders lost 100% of their investment
- No personal debt inheritance



Stock market listings

- A small sample of stocks traded on the New York Stock Exchange
- 0.8 in NET CHG column: HSY's change in close price from the previous trading day
- 2.89 in dividend column: the last quarterly dividend payment was $.7225 per share (a fraction of earnings)
- 2.72 in annual dividend yield column: $2.89/$106.24 = .0272

NAME	SYMBOL	CLOSE	NET CHG	VOLUME	52 WK HIGH	52 WK LOW	DIV	YIELD	P/E	YTD %CHG
Herbalife Nutrition	HLF	57.94	−1.39	1,149,773	60.41	34.16	1.20	2.07	47.75	−1.71
Herc Holdings	HRI	26.86	−0.71	389,826	72.99	24.16	....	....	3.10	3.35
Heritage Insurance Holdings	HRTG	14.57	−0.38	81,929	19.15	12.85	0.24	1.65	22.01	−1.02
Hersha Hospitality Trust Cl A	HT	16.59	−0.16	732,879	24.16	16.50	1.12	6.75	...dd	−5.42
Hershey	HSY	106.24	0.80	1,145,889	114.63	89.10	2.89	2.72	22.00	−0.88
Hertz Global Holdings	HTZ	13.27	−0.77	2,965,201	25.14	13.01	....	....	2.24	−2.78
Hess Corp.	HES	42.39	0.15	5,969,511	74.81	35.59	1.00	2.36	...dd	4.67
Hess Midstream Partners	HESM	17.87	0.25	47,899	24.51	16.17	1.43	8.00	14.60	5.24
Hewlett Packard Enterprise	HPE	13.18	−0.28	11,756,695	19.48	12.09	0.45	3.41	11.46	−0.23

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Dividend yield

- The dividend yield is only part of the return on a stock investment
- Another part is prospective capital gains (i.e., price increases) or losses
- Low-dividend firms presumably offer greater prospects for capital gains, or investors would not be willing to hold these stocks in their portfolios

NAME	SYMBOL	CLOSE	NET CHG	VOLUME	52 WK HIGH	52 WK LOW	DIV	YIELD	P/E	YTD %CHG
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P/E ratio

- The P/E ratio or **price-earnings ratio**: the ratio of stock price to last year's earnings per share
  - Indicates how much stock purchasers must pay per dollar of earnings that the firm generates
- When dividend yield and P/E ratio are not reported, the firms have zero dividends, or zero or negative earnings

Preferred stock

- **Preferred stock** promises to pay a fixed amount of income each year
- Compare to common stock
  - No voting power
  - **Preferred dividends** are usually *cumulative:* unpaid dividends cumulate and need to be paid in full before being paid to holders of common stock
- Compare to bond
  - Similar to an infinite-maturity bond
  - No contractual obligation to pay preferred dividends, but contractual obligation to make the interest payments on the debt

Example: JPM preferred stock

JPMORGAN CHASE & CO. 4.2% PFD Callable **JPM/PRM:** NYSE Buy Sell

$16.67 +$0.0200 (+0.12%)
After hours: 8:00:00 PM ET, 09/08/2026

$16.67 +$0.0200 (+0.12%)
At close: 4:00:00 PM ET, 09/08/2026

Previous close	Today's open	Today's volume
$16.65	$16.68	225.5K ▲Above Avg.

Today's range		52-week range	
$16.65	$16.77	$16.23	$19.81

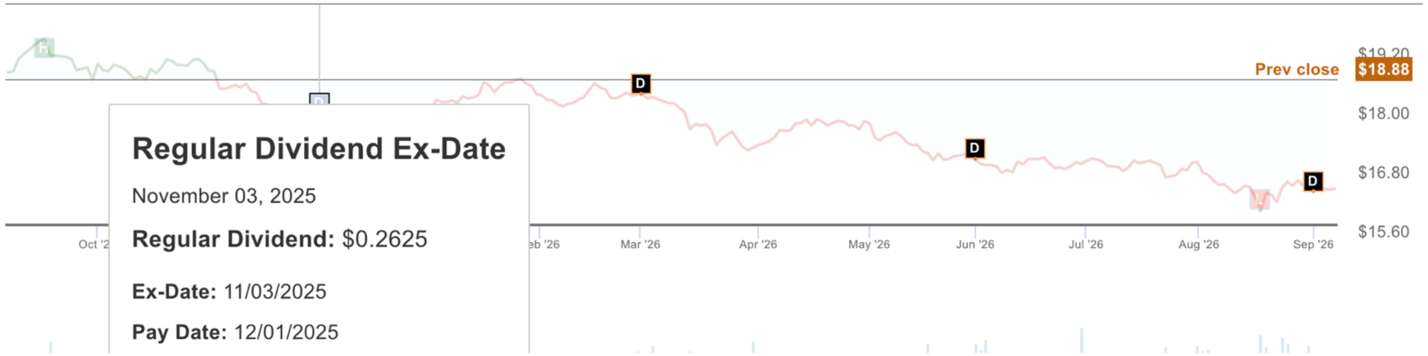
Margin Requirements

Chart

Timeframe

1D 5D 1M 3M 6M YTD 1Y 3Y 5Y

Show events Table view -$2.21 (-11.71%)



Dividend/Coupon Features

Current Yield	6.29%
Previous Payment	$0.26
Indicated Annual Rate	$1.05
Previous Ex-Date	Aug 3, 2026
Previous Payment Date	Sep 1, 2026
Payment Frequency	Quarterly, constant rate

Stated Call

Stated Call	Yes
Regular Call Price	$25.00
Call Type	Callable exclusively into cash
Next Call Date	Dec 1, 2026
Call Timing	On payment dates only

Payment Type	Fixed dividend payment over the life; stated in the prospectus as an annual dividend percentage rate
Cumulative	No
Qualified	Qualified tax status is unknown

Stock market indexes

- Well known stock market indexes include
  - Dow Jones Industrial Average: 30 large, "blue-chip" corporations
  - Standard & Poor's Composite 500 (S&P 500): about 500 firms
  - NASDAQ: more than 3,000 firms traded on the NASDAQ stock exchange
  - NASDAQ 100 is a subset of the larger firms in NASDAQ
  - …

Price-weighted average

- Example: Dow Jones Industrial Average
- Originally, back in 1896, the Dow was the average price of stocks in the index
- Consider the two-stock version of the Dow
  - Stock ABC starts at $25 a share and increases to $30
  - Stock XYZ starts at $100, but falls to $90
  - Initial index value $= (25 + 100)/2 = 62.5$
  - Final index value $= (30 + 90)/2 = 60$
  - Percentage change in index $= -2.5/62.5 = -.04 = -4\%$

Stock	Initial Price	Final Price	Shares (million)	Initial Value of Outstanding Stock ($ million)	Final Value of Outstanding Stock ($ million)
ABC	$ 25	$30	20	$500	$600
XYZ	100	90	1	100	90
Total				$600	$690

The Dow now

- The Dow no longer equals the average price of the 30 stocks because the averaging procedure is adjusted for two events
  - a stock splits or pays a stock dividend of more than 10%
  - one company in the group of 30 industrial firms is replaced by another

- To leave the indexed unaffected by two events, the **divisor** to compute the "average price" is adjusted
  - By June 26, 2026, the divisor for the Dow is .1682 when Alphabet joined the index (and Verizon left)

Divisor adjustment in stock splits

- Suppose XYZ splits two for one so that its share price falls to $\$50$
- The index value before the stock split: $(25 + 100)/2 = 62.5$
- We find a new divisor, d, that leaves the index unchanged. We solve d in the following equation

$$\frac{Price\ of\ ABC + Price\ of\ XYZ}{d} = \frac{25 + 50}{d} = 62.5$$

- $d = \frac{25+50}{62.5} = 1.2$

Stock	Initial Price	Final Price	Shares (million)	Initial Value of Outstanding Stock ($ million)	Final Value of Outstanding Stock ($ million)
ABC	$ 25	$30	20	$500	$600
XYZ	100	90	1	100	90
Total				$600	$690

Stock	Initial Price	Final Price	Shares (million)	Initial Value of Outstanding Stock ($ million)	Final Value of Outstanding Stock ($ million)
ABC	$25	$30	20	$500	$600
XYZ	50	45	2	100	90
Total				$600	$690

Rate of return after the splits

- The split changes the price of XYZ and the relative weights of the two stocks in the price-weighted average. Therefore, the return of the index is also affected

- Initial index value before the split = $(25 + 100)/2 = 62.5$
- Final index value after the split and price change = $(30 + 45)/1.2 = 62.5$
- Percentage change in index = 0

Stock	Initial Price	Final Price	Shares (million)	Initial Value of Outstanding Stock ($ million)	Final Value of Outstanding Stock ($ million)
ABC	$ 25	$30	20	$500	$600
XYZ	100	90	1	100	90
Total				$600	$690

Stock	Initial Price	Final Price	Shares (million)	Initial Value of Outstanding Stock ($ million)	Final Value of Outstanding Stock ($ million)
ABC	$25	$30	20	$500	$600
XYZ	50	45	2	100	90
Total				$600	$690

Companies included in the Dow: 1928, 2019 & 2026

Dow Industrials in 1928	Current Dow Companies	Ticker Symbol	Industry	Year Added to Index
Wright Aeronautical	3M	MMM	Diversified industrials	1976
Allied Chemical	American Express	AXP	Consumer finance	1982
North American	Apple	AAPL	Electronic equipment	2015
Victor Talking Machine	Boeing	BA	Aerospace and defense	1987
International Nickel	Caterpillar	CAT	Construction	1991
International Harvester	Chevron	CVX	Oil and gas	2008
Westinghouse	Cisco Systems	CSCO	Computer equipment	2009
Texas Gulf Sulphur	Coca-Cola	KO	Beverages	1987
Texas Corp	Disney	DIS	Broadcasting and entertainment	1991
Standard Oil (NJ)	DowDuPont	DWDP	Chemicals	1935
General Electric	ExxonMobil	XOM	Oil and gas	1928
American Tobacco	Goldman Sachs	GS	Investment banking	2013
Sears Roebuck	Home Depot	HD	Home improvement retailers	1999
General Motors	Intel	INTC	Semiconductors	1999
Chrysler	IBM	IBM	Computer services	1979
Atlantic Refining	Johnson & Johnson	JNJ	Pharmaceuticals	1997
Paramount Publix	JPMorgan Chase	JPM	Banking	1991
Bethlehem Steel	McDonald's	MCD	Restaurants	1985
General Railway Signal	Merck	MRK	Pharmaceuticals	1979
Mack Trucks	Microsoft	MSFT	Software	1999
Union Carbide	Nike	NKE	Apparel	2013
American Smelting	Pfizer	PFE	Pharmaceuticals	2004
American Can	Procter & Gamble	PG	Household products	1932
Postum Inc	Travelers	TRV	Insurance	2009
Nash Motors	UnitedHealth Group	UNH	Health insurance	2012
American Sugar	United Technologies	UTX	Aerospace	1939
Goodrich	Verizon	VZ	Telecommunications	2004
Radio Corp	Visa	V	Electronic payments	2013
Woolworth	Walgreens Boots	WBA	Pharmaceuticals	2018
U.S. Steel	Walmart	WMT	Retailers	1997

Table 2.4 9/10/2026

Companies included in the Dow Jones Industrial Average: 1928 and 2019

#	Company	Symbol	Weight		Price	Chg	% Chg
1	Goldman Sachs Group ...	GS	11.69%	▼	1031.26	-5.27	-0.51%
2	Caterpillar Inc.	CAT	9.27%	▼	817.75	-4.73	-0.57%
3	Microsoft Corp	MSFT	5.58%	▼	492.03	-1.92	-0.39%
4	UNITEDHEALTH GROU...	UNH	4.44%	▼	391.97	-8.87	-2.21%
5	Amgen Inc	AMGN	4.44%	▼	391.39	-1.78	-0.45%
6	VISA Inc.	V	4.18%	▼	368.31	-0.33	-0.09%
7	The Travelers Compani...	TRV	4.16%	▲	366.63	0.96	0.26%
8	JPMorgan Chase & Co.	JPM	4.03%	▲	355.01	1.50	0.42%
9	Alphabet Inc. Class A C...	GOOGL	3.74%	▼	329.63	-8.73	-2.58%
10	American Express Com...	AXP	3.65%	▼	322.00	-4.10	-1.26%
11	The Sherwin-Williams C...	SHW	3.64%	▼	321.06	-5.03	-1.54%
12	Apple Inc.	AAPL	3.56%	▼	313.63	-2.59	-0.82%
13	Home Depot, Inc.	HD	3.52%	▼	310.42	-3.28	-1.05%
14	Johnson & Johnson	JNJ	3.03%	▼	267.15	-1.97	-0.73%
15	McDonald's Corporation	MCD	2.88%	▼	253.75	-2.06	-0.81%
16	Amazon.Com Inc	AMZN	2.85%	▼	251.27	-5.70	-2.22%
17	Salesforce, Inc.	CRM	2.80%	▼	247.22	-1.90	-0.76%
18	International Business ...	IBM	2.67%	▲	235.38	3.29	1.42%
19	Nvidia Corp	NVDA	2.54%	▼	224.15	-1.58	-0.70%
20	Chevron Corporation	CVX	2.41%	▲	212.88	3.08	1.47%
21	Boeing Company	BA	2.38%	▼	209.85	-0.88	-0.42%
22	Honeywell Internationa...	HON	2.34%	▼	206.48	-1.76	-0.84%
23	3M Company	MMM	1.87%	▼	165.31	-2.22	-1.32%
24	Merck & Co., Inc.	MRK	1.67%	▼	147.64	-0.82	-0.55%
25	Procter & Gamble Com...	PG	1.62%	▼	142.81	-2.77	-1.90%
26	Cisco Systems, Inc. Co...	CSCO	1.24%	▲	109.50	0.33	0.31%
27	Walmart Inc. Common ...	WMT	1.20%	▼	105.91	-0.14	-0.13%
28	The Walt Disney Comp...	DIS	1.18%	▼	104.23	-0.83	-0.79%
29	Coca-Cola Company	KO	1.00%	▼	88.01	-0.35	-0.40%
30	Nike, Inc.	NKE	0.42%	▼	37.10	-1.00	-2.64%

As of Sept 9, 2026

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Market-value-weighted average

- Example: S&P 500, NASDAQ, NASDAQ 100
- The initial value was $\$600M$, and the final value is $\$690M$
- Suppose the initial index value is set as 100 (can also set as other value)
- Final index value $= 100 \times (690/600) = 115$
- Percentage change in index $= 115/100 - 1 = 0.15 = 15\%$
- Percentage change not affected by stock splits

Stock	Initial Price	Final Price	Shares (million)	Initial Value of Outstanding Stock ($ million)	Final Value of Outstanding Stock ($ million)
ABC	$ 25	$30	20	$500	$600
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XYZ	50	45	2	100	90
Total				$600	$690

Composition of S&P 500 and NASDAQ 100

S&P 500
Top 30 components
As of Sept 9, 2026

#	Company	Symbol	Weight		Price	Chg	% Chg
1	Nvidia Corp	NVDA	7.80%	▼	224.10	-1.63	-0.72%
2	Apple Inc.	AAPL	6.60%	▼	313.85	-2.37	-0.75%
3	Microsoft Corp	MSFT	5.27%	▼	492.24	-1.71	-0.35%
4	Amazon.Com Inc	AMZN	3.91%	▼	251.40	-5.57	-2.17%
5	Alphabet Inc. Class A C...	GOOGL	2.99%	▼	329.62	-8.74	-2.58%
6	Alphabet Inc. Class C C...	GOOG	2.80%	▼	327.38	-8.00	-2.39%
7	Broadcom Inc. Commo...	AVGO	2.48%	▼	361.36	-7.20	-1.95%
8	Meta Platforms, Inc. Cl...	META	2.39%	▲	650.19	36.71	5.98%
9	Tesla, Inc. Common Sto...	TSLA	2.10%	▲	369.77	1.61	0.44%
10	Micron Technology, Inc.	MU	1.66%	▲	1021.80	21.54	2.15%
11	BERKSHIRE HATHAWAY...	BRK.B	1.56%	▲	507.05	1.22	0.24%
12	Eli Lilly & Co.	LLY	1.44%	▲	1125.04	1.13	0.10%
13	JPMorgan Chase & Co.	JPM	1.36%	▲	355.04	1.53	0.43%
14	Advanced Micro Devices	AMD	1.23%	▲	523.11	17.37	3.43%
15	Walmart Inc. Common ...	WMT	1.21%	▼	105.89	-0.16	-0.15%
16	VISA Inc.	V	0.99%	▼	368.14	-0.50	-0.13%
17	ExxonMobil Holdings C...	XOM	0.97%	▲	163.66	3.00	1.87%
18	Johnson & Johnson	JNJ	0.93%	▼	266.86	-2.26	-0.84%
19	Intel Corp	INTC	0.81%	▲	106.24	1.77	1.70%
20	Mastercard Incorporated	MA	0.72%	▼	568.45	-2.44	-0.43%
21	Oracle Corp	ORCL	0.67%	▼	161.86	-0.66	-0.40%
22	ABBVIE INC.	ABBV	0.63%	▲	249.10	0.32	0.13%
23	Bank of America Corpo...	BAC	0.63%	▲	62.78	0.39	0.63%
24	Cisco Systems, Inc. Co...	CSCO	0.62%	▲	109.62	0.45	0.41%
25	Chevron Corporation	CVX	0.60%	▲	212.78	2.98	1.42%
26	Palantir Technologies I...	PLTR	0.59%	▲	170.68	0.38	0.22%
27	Costco Wholesale Corp	COST	0.57%	▼	898.63	-11.55	-1.27%
28	Lam Research Corp	LRCX	0.57%	▼	315.65	-4.77	-1.49%
29	Coca-Cola Company	KO	0.54%	▼	87.89	-0.47	-0.53%
30	Caterpillar Inc.	CAT	0.54%	▼	817.30	-5.18	-0.63%

#	Company	Symbol	Weight		Price	Chg	% Chg
1	Nvidia Corp	NVDA	13.04%	▼	224.17	-1.56	-0.69%
2	Apple Inc.	AAPL	11.03%	▼	313.77	-2.45	-0.78%
3	Microsoft Corp	MSFT	8.81%	▼	492.31	-1.64	-0.33%
4	Amazon.Com Inc	AMZN	6.54%	▼	251.66	-5.31	-2.06%
5	Alphabet Inc. Class A C...	GOOGL	5.00%	▼	329.74	-8.62	-2.55%
6	Alphabet Inc. Class C C...	GOOG	4.68%	▼	327.48	-7.90	-2.36%
7	Space Exploration Tech...	SPCX	4.64%	▼	145.95	-7.52	-4.90%
8	Broadcom Inc. Commo...	AVGO	4.14%	▼	361.24	-7.32	-1.99%
9	Meta Platforms, Inc. Cl...	META	3.99%	▲	650.34	36.86	6.01%
10	Tesla, Inc. Common Sto...	TSLA	3.53%	▲	370.45	2.29	0.62%
11	Micron Technology, Inc.	MU	2.78%	▲	1022.94	22.68	2.27%
12	Advanced Micro Devices	AMD	2.06%	▲	523.55	17.81	3.52%
13	Walmart Inc. Common ...	WMT	2.02%	▼	105.88	-0.17	-0.16%
14	ASML Holding NV	ASML	1.61%	▼	1738.90	-25.95	-1.47%
15	Intel Corp	INTC	1.35%	▲	106.24	1.77	1.70%
16	Cisco Systems, Inc. Co...	CSCO	1.04%	▲	109.64	0.47	0.43%
17	Palantir Technologies I...	PLTR	0.99%	▲	170.71	0.41	0.24%
18	Costco Wholesale Corp	COST	0.96%	▼	898.76	-11.42	-1.25%
19	Lam Research Corp	LRCX	0.95%	▼	315.74	-4.68	-1.46%
20	Applied Materials Inc	AMAT	0.90%	▼	468.45	-4.34	-0.92%
21	NetFlix Inc	NFLX	0.77%	▼	76.33	-0.44	-0.57%
22	Arm Holdings plc Amer...	ARM	0.68%	▲	264.90	3.37	1.29%
23	Palo Alto Networks, Inc...	PANW	0.66%	▼	335.00	-1.98	-0.59%
24	Sandisk Corporation C...	SNDK	0.63%	▲	1780.50	42.51	2.45%
25	Texas Instruments Inco...	TXN	0.58%	▲	262.39	3.47	1.34%
26	KLA Corporation Com...	KLAC	0.57%	▼	182.56	-6.42	-3.40%
27	Linde plc Ordinary Share	LIN	0.52%	▼	465.79	-2.59	-0.55%
28	Marvell Technology, Inc...	MRVL	0.51%	▲	237.38	11.97	5.31%
29	CrowdStrike Holdings, I...	CRWD	0.51%	▼	208.08	-1.94	-0.92%
30	Amgen Inc	AMGN	0.51%	▼	391.29	-1.88	-0.48%

NASDAQ 100
Top 30 components
As of Sept 9, 2026

Large companies not in DASDAQ: IBM, GE, ExxonMobil, JP Mogan, …

Equally weighted average

- Equally weighted average of the returns of each stock in an index
- Equivalent to a portfolio strategy that invests equal dollar values in each stock
- Initial index value $= 2$ ($\$1$ in ABC and $\$1$ in XYZ)
- Final index value $= \frac{30}{25} \times 1 + \frac{45}{50} \times 1 = 1.2 + 0.9 = 2.1$
- Percentage change in index $= \frac{2.1}{2} - 1 = 5\%$
  - Average of 20% of ABC and -10% of XYZ

Stock	Initial Price	Final Price	Shares (million)	Initial Value of Outstanding Stock ($ million)	Final Value of Outstanding Stock ($ million)
ABC	$25	$30	20	$500	$600
XYZ	50	45	2	100	90
Total				$600	$690

EMORY

Invest in market indexes

- One way is to purchase *index funds* (shares in mutual funds that hold shares in proportion to their representation in the S&P 500 or another index)
  - Purchase directly from the fund or through brokers or financial advisers

FXAIX

Fidelity® 500 Index Fund

NTF No Transaction Fee 1

Daily Info AS OF 09/08/2026

NAV
$267.11 NAV Change -1.56 (-0.58%)

YTD Returns
+12.98%

Morningstar® Snapshot* AS OF 08/31/2026

Morningstar Category: Large Blend

Overall Rating — Out of 1,211 funds
Returns — Low Avg High
Expenses — Low Avg High

*Data provided by Morningstar

Summary | Performance & Risk | Ratings | Composition | Fee

Details

Morningstar Category		Large Blend
Fund Inception		02/17/1988
Share Class Inception		05/04/2011
Exp Ratio (Gross)	04/29/2026	0.015%
Exp Ratio (Net)	04/29/2026	0.015%
NAV	09/08/2026	$267.11
Minimum to Invest		$0.00
Turnover Rate	02/28/2026	3.00%
Portfolio Net Assets ($M)	08/31/2026	$859,163.12
12 Month Low-High	08/31/2026	$220.95 - $271.20

VFIAX

Vanguard 500 Index Fund Admiral Shares

Also available as an ETF (starting at the price of $1).

Buy Compare

Management style: Index	Asset class: Domestic Stock - General
Category: Large Blend	Risk / reward scale: 4 (Less – More)
Expense ratio: 0.04% (as of 04/28/2026)	30 day SEC yield: 0.97% B (as of 08/31/2026)
Investment minimum: $3,000 (as of 09/08/2026)	NAV price: $709.41 (as of 09/08/2026)

EMORY

Invest in market indexes

- Another approach is to purchase an *exchange-traded fund*, or ETF, which is a portfolio of shares that can be bought or sold as a unit, just as one can buy or sell a single share of stock
  - Trade index portfolios as stocks
  - Lower management cost