Discovering Undervalued and Overvalued Stocks

Stocks in cluster 2 are likely overvalued while those in cluster 7 may be undervalued. Further research is needed for investment and divestment decisions.

By Bruce Hou (Change-Hung Hou)

Value investing, an investment strategy that originates from Benjamin Graham and Warren Buffet, involves selecting stocks based on its 'intrinsic value'. Investors who follow this approach calculate ideal stock prices with the analysis of financial ratios and internal and external factors. They then compare the calculated stock price to the current stock price. They invest in 'undervalued stock', whose ideal price is higher than current price, and divest in 'overvalued stock', whose ideal price is lower than their current price. However, increasing numbers of companies' disclosures, press releases, and comments in social media, make manually reviewing all related information impossible. This project aims to create a prototype that automates all stock selection processes with unsupervised machine learning models. Our analysis could generally define both overvalued and undervalued stocks with a data analytics approach.

Methods

The dataset contains 500+ US companies and 30+ financial ratios and stock prices in 2018. We first clean our dataset by filling null values with 0. Next, we compute correlation between financial variables and stock price. Financial factors that are moderately ($0.4 < r < 0.7$) or highly ($r > 0.7$) correlated with stock price will be selected to feed into unsupervised machine learning model. Within the model, we conduct various types of clustering methods. We choose "Cosine" + "Complete" for categorizations of stocks and separate stocks into 8 groups given their well-performed clustering results.

Results

After categorizing the stocks, we analyze the stock's intrinsic value based on its' relationships with highly and moderately correlated financial ratios. Within the measurement of highly correlated variables, stocks in cluster 2 possess the highest financial ratios (EPS, Book value of equity per share, free cash flow per share) and the highest stock prices on average. As large values of financial ratios stick to high stock prices and vice versa, no undervalued or overvalued stocks are detected in this case. (**Fig 1.**)

Moderately correlated variables, however, indicate a different result. Shareholders' equity, Earnings available for common stockholders, and Earnings are high in cluster 7 while its stock price is relatively low. Given that high financial ratios do not reflect on stock prices, we may regard stocks in cluster 7

as undervalued. Comparatively, financial ratios appear lower in cluster 2 while its stock price is abnormally high. We may consider stocks in cluster 2 overvalued. (**Fig 2.**)
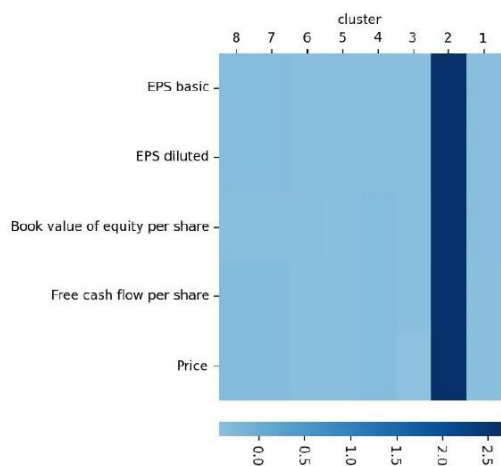

Fig 1. Relative value of strongly correlated variables and stock price by cluster.
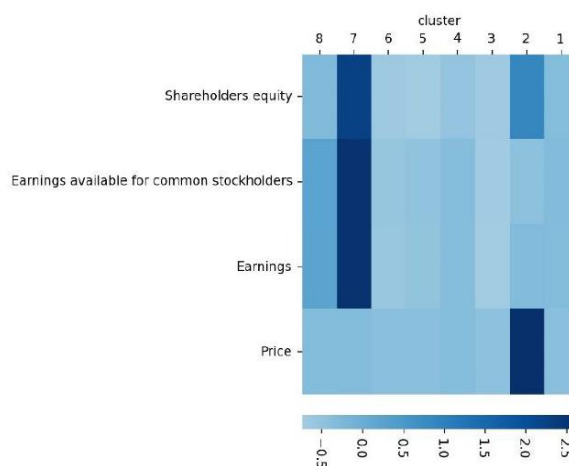
Fig 2. Relative value of normally correlated variables and stock price by cluster

Challenges of Analysis and Business Suggestions

Evaluation of stocks with listed financial factors may be biased and could inaccurately reflect 'true value' of stocks. Though we already proved those variables are positively correlated with stock price, we are unsure if they make sense from an investment perspective. Also, we analyze the average of stock price and financial factors for each group while not discussing the range and standard deviation of data. Thus, results regarding overall value of a cluster may differ from the value of an individual company's stock.

Even though all stocks in cluster 7 are indeed undervalued and those in cluster 2 are truly overvalued, we could not recommend investing in the former while divesting in the latter. Our analysis does not measure factors other than finance, including but not limited to business model, future growth, and industrial characteristics. These factors could play an equally important role in measuring the value of the stock itself.

Overall, this model can merely pre-screen overvalued and undervalued stocks. We recommend the investment firm commence further analysis for individual stocks within these clusters before making investment decisions.

Appendix: Clusters of Stocks

Clusters	Tickers
1	'CRM', 'SNPS', 'CSCO', 'URI', 'GRA', 'ALK', 'DHI', 'MRO', 'ATVI', 'ZION', 'QSII', 'KIM', 'Q', 'LUV', 'DNR', 'PMTC', 'DISH', 'ABK', 'WY', 'REG', 'ARE', 'NTRS', 'NFLX', 'RRC', 'ETFC', 'FISV', 'CTXS', 'PCG', 'VIA', 'MTB', 'O', 'CNX', 'PHM', 'MAA', 'MYL', 'STI', 'EQR', 'SLM', 'IT', 'NFX', 'SLG', 'BEN', 'GPN', 'EXR', 'FHN', 'HBAN', 'AFL', 'AMG', 'ACC', 'SBAC', 'TMK', 'PBCT', 'COG', 'IVZ', 'BSX', 'WPX', 'VTR', 'CNP', 'PXD', 'CXO', 'NBL', 'UDR', 'PLD', 'CFG', 'NYT', 'HAL', 'PCAR', 'PGR', 'BMY', 'GLAD', 'PNC', 'CMA', 'DFS', 'NCLH', 'VRSK', 'FITB', 'HST', 'AAN', 'RF', 'KEY', 'SYMC', 'FTV', 'INFO', 'RHT', 'KBH', 'LEN', 'CAG', 'GGP', 'LVLT', 'STR', 'PCL', 'HCBK', 'FRX', 'NYX', 'BMC', 'XTO', 'EQ', 'BUD', 'SAF'
2	'AZO', 'LTD', 'HRB', 'NAV', 'DE', 'HD', 'NWL', 'JPM', 'DNB', 'CLX', 'CHK', 'MS', 'ETR', 'AMT', 'BRK', 'MET', 'MGM', 'NAVI', 'FCX', 'CF', 'FE', 'BXP', 'SBUX', 'FPL', 'EXC', 'CL', 'GS', 'DVA', 'BBT', 'PEG', 'APC', 'AIG', 'HCA', 'THC', 'STT', 'UPS', 'MAS', 'DUK', 'D', 'SYF', 'FRE', 'ORLY', 'ACE', 'WMB', 'KMB', 'SO', 'BAC', 'ALL', 'SRE', 'BK', 'AXP', 'AVP', 'EXPE', 'PFG', 'VNO', 'MPC', 'USB', 'AMP', 'COF', 'CI', 'RRD', 'SCHW', 'PPL', 'EK', 'TRV', 'WHR', 'FNM', 'C', 'AES', 'UTX', 'WFC', 'PYPL', 'LNC', 'GNW', 'IDXX', 'ED', 'UIS', 'MHP', 'GE', 'EIX', 'PBI', 'AMCX', 'MCO', 'HLT', 'LTR', 'LMT', 'AEP', 'PRU', 'EQT', 'APA', 'HCN', 'DIS', 'MOT', 'SYNT', 'XL', 'TSO', 'MJN', 'SE', 'CVC', 'TWC', 'WFR', 'DTV', 'WAG', 'EP', 'RX', 'NCC', 'WB', 'MER', 'LEH', 'CFC', 'BSC'
3	'SHLD', 'JCP', 'SIG', 'GME', 'ADSK', 'CIEN', 'DISC', 'XYL', 'XRAY', 'XEL', 'LUK', 'CNO', 'CR', 'PNW', 'AKRX', 'GLW', 'IPG', 'SEE', 'HES', 'CZN', 'NWS', 'TDC', 'AA', 'AEE', 'NRG', 'CIT', 'MAT', 'NE', 'AIZ', 'ENDP', 'MBI', 'WU', 'CMS', 'SWN', 'HIG', 'COTY', 'GT', 'HOG', 'BHF', 'NI', 'EBAY', 'BLL', 'TSLA', 'UNM', 'DTE', 'OI', 'FLS', 'SCG', 'AFG', 'RJF', 'NBR', 'DDR', 'WFT', 'AHL', 'JDSU', 'HOLX', 'KMX', 'DYN', 'CPN', 'SPLS', 'STJ', 'LXK', 'ASH', 'TE', 'ADT', 'GAS', 'POM', 'ANR', 'TEG', 'MWV', 'RSH', 'CMVT', 'PGN', 'CEG', 'TIN', 'MI', 'AYE', 'PTV', 'BDK', 'PBG', 'JAVA', 'CTX', 'ROH', 'SOV', 'AW', 'HPC', 'TT'
4	'KSS', 'SJM', 'CPB', 'NTAP', 'AJG', 'NLSN', 'AOC', 'IRM', 'DOV', 'EQIX', 'APD', 'AVB', 'PX', 'MMC', 'HAS', 'CINF', 'GCI', 'SPG', 'MUR', 'XRX', 'FRT', 'WLTW', 'ADS', 'APU', 'WYNN', 'WEC', 'HCP', 'BLK', 'MCD', 'BDX', 'ROK', 'ADP', 'RE', 'CMI', 'AWK', 'WYN', 'R', 'NU', 'FBHS', 'EMN', 'PNR', 'RCL', 'PSA', 'LNT', 'OKE', 'DLR', 'MCHP', 'MDP', 'CCI', 'GPC', 'PH', 'MAC', 'PPG', 'ESS', 'SWK', 'RL', 'HBI', 'WDC', 'HRS', 'MKC', 'DRI', 'DPS', 'DD', 'LLL', 'HOT', 'ARG', 'CB', 'KRFT', 'OMX', 'HNZ', 'BNI'
5	'BIG', 'DLTR', 'FL', 'HIBB', 'TJX', 'ROST', 'ULTA', 'BBY', 'M', 'JWN', 'AEO', 'GPS', 'DG', 'URBN', 'DCI', 'HRL', 'CHRW', 'ACM', 'AN', 'CMG', 'CRVL', 'LEG', 'MED', 'JBHT', 'DLPH', 'EL', 'EXPD', 'FLR', 'AOS', 'RHI', 'CBG', 'DF', 'HSIC', 'VFC', 'NUE', 'TSCO', 'ARW', 'AMD', 'LSTR', 'SYY', 'AVY', 'SAM', 'TSN', 'KORS', 'SVU', 'RAD', 'JBL', 'NKE', 'AYI', 'NUS', 'WFMI', 'NILE', 'FDO', 'BRLI', 'PETM', 'SAPE', 'SWY',

	'SLE', 'CBE', 'SUN', 'MHS', 'WWY'
6	'PVH', 'ANF', 'ADI', 'BKE', 'DDS', 'COO', 'RAVN', 'TIF', 'A', 'PDCO', 'AAP', 'RIG', 'FSLR', 'ISRG', 'ACXM', 'ROP', 'LH', 'UA', 'ETN', 'ALB', 'ATI', 'ITT', 'HP', 'TDG', 'MLM', 'BAX', 'UG', 'ECL', 'COL', 'RMD', 'TAP', 'AKAM', 'VIVO', 'LM', 'LKQ', 'WIN', 'TSS', 'X', 'RDC', 'TRIP', 'CA', 'NOV', 'AMSC', 'RSG', 'FLIR', 'AGCO', 'WDR', 'IFF', 'NEM', 'UHS', 'APH', 'ESV', 'NDAQ', 'AMR', 'SRCL', 'WPO', 'SYK', 'DO', 'SSP', 'TER', 'VMC', 'CBOE', 'BTU', 'BMS', 'ACIW', 'PFIE', 'ARRS', 'PKI', 'DGX', 'AME', 'BWA', 'MTW', 'PETS', 'EFX', 'ALXN', 'ANSS', 'INCY', 'IACI', 'FAST', 'TEX', 'PWR', 'CTSH', 'MOS', 'OFLX', 'FIS', 'DV', 'TKR', 'ZMH', 'IR', 'JNPR', 'SNA', 'XLNX', 'FOSL', 'QRVO', 'CERN', 'GRMN', 'CDNS', 'TXT', 'PRGO', 'SANM', 'ODP', 'WAT', 'BC', 'MHK', 'COH', 'SAI', 'VAR', 'JEC', 'SWKS', 'BBBY', 'CTAS', 'CVG', 'WRK', 'SNI', 'BCR', 'BHI', 'LIZ', 'JNS', 'YHOO', 'LLTC', 'HAR', 'APOL', 'LNKD', 'ACAS', 'FTI', 'QLGC', 'TYC', 'SNDK', 'CAM', 'BRCM', 'SIAL', 'PCP', 'ALTR', 'HSP', 'PLL', 'IGT', 'CFN', 'CPWR', 'LSI', 'FO', 'JNY', 'LIFE', 'MOLX', 'TLAB', 'CVH', 'TIE', 'GR', 'NVLS', 'NSM', 'ACV', 'CRA', 'MFE', 'GENZ', 'ADCT', 'KG', 'SII', 'MIL', 'BJS', 'ACS', 'BRL', 'ABI', 'EDS', 'ANDW', 'SBL'
7	'ORCL', 'MU', 'HPE', 'HPQ', 'MDT', 'KMI', 'DVN', 'AMGN', 'CMCS', 'VZ', 'ABT', 'PM', 'PG', 'CVX', 'CTL', 'SLB', 'ICE', 'MRK', 'EOG', 'V', 'CME', 'HON', 'JNJ', 'FB', 'OXY', 'AMZN', 'LLY', 'GOOG', 'T', 'JCI', 'S', 'COP', 'IBM', 'ABBV', 'XOM', 'KFT', 'MSFT', 'DOW', 'MO', 'WPI', 'GILD', 'PFE', 'KHC', 'AAPL', 'TMO', 'INTC', 'KO', 'DHR', 'PEP', 'CCL', 'TWX', 'RAI', 'EMC', 'DELL', 'SGP', 'WYE'
8	'FDX', 'PAYX', 'ACN', 'WBA', 'GIS', 'COST', 'KR', 'TGT', 'LOW', 'WMT', 'BF', 'INTU', 'AMAT', 'NVDA', 'ESRX', 'RTN', 'TWTR', 'XEC', 'AIV', 'CNC', 'VLO', 'CBS', 'MMM', 'CSC', 'REGN', 'YUM', 'CLF', 'EW', 'WLP', 'ZTS', 'QCOM', 'UNP', 'MTD', 'MNST', 'GWW', 'ABC', 'KSU', 'CHD', 'MA', 'DAL', 'GM', 'CSX', 'NOC', 'KLAC', 'ITW', 'VRSN', 'CAT', 'BIIB', 'IP', 'PCLN', 'PSX', 'UNH', 'ERTS', 'CAH', 'WEN', 'SHW', 'FMC', 'FFIV', 'LYB', 'MTG', 'NSC', 'CVS', 'F', 'HUM', 'WM', 'VRTX', 'PKG', 'CELG', 'HSY', 'MCK', 'AET', 'GD', 'OMC', 'EMR', 'ALEX', 'ADM', 'ALLE', 'DRE', 'TXN', 'FII', 'UAL', 'TROW', 'ALGN', 'ILMN', 'BA', 'MAR', 'ABMD', 'K', 'WINA', 'MNK', 'TEL', 'STX', 'LRCX', 'STZ', 'ADBE', 'FDS', 'MON', 'AVGO', 'CSRA', 'CCE', 'AGN', 'COV', 'NOVL', 'UST', 'CCU'