

# Bootstrapped Backtesting of Equity Portfolios

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## Introduction

Our objective is to explore three different investment strategies which incorporate two popular financial ratios: dividend yield (DIV) and price to earnings (P/E). The investment strategies each assign a weight to DIV and P/E as a ratio (DIV:P/E); either 1:0, 1:1, or 0:1. 10,000 bootstrapped samples were simulated every year from 1970-2009 to find the optimal investment strategy. The optimal portfolio would maximize return while minimizing risk, or the return's variance. We also compare two dividend yield cutoffs to see how this affects each of the three strategies.

## Data

Wharton Research Data Services website:

- [CRSP / COMPUSTAT merged databases for annual inflation and company fundamentals](#)
- [CRSP database for monthly prices](#)

Yahoo Finance:

- [Historic monthly S&P500 index values](#)

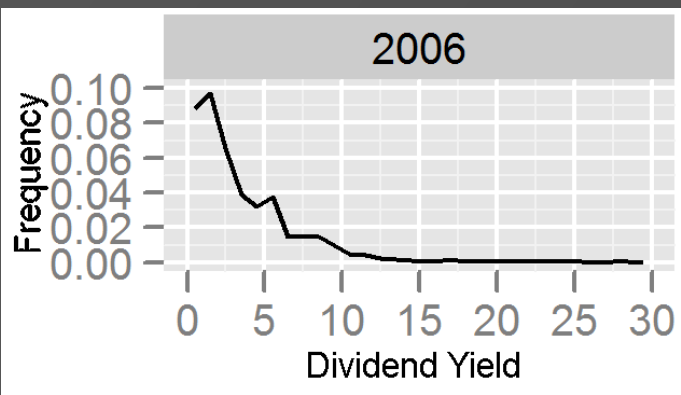
## Approach

For each year, the stocks under consideration were narrowed to those with:

- a price greater than \$1, and less than \$5,000 in unadjusted dollars
- a market cap greater than MM\$300, in inflation adjusted dollars indexed to 2009
- both a common stock dividend yield and a P/E ratio greater than zero
- a common stock dividend yield less than some maximum  $D_{max}$

Stocks were ranked separately by dividend yield and P/E ratio, and then assigned a final rank based on a weighted average of those. The top 100 ranked stocks were eligible for consideration in a given year.

Portfolios were then constructed by choosing ten stocks randomly from the list of 100. Both principle and gains were reinvested annually using the same strategy.



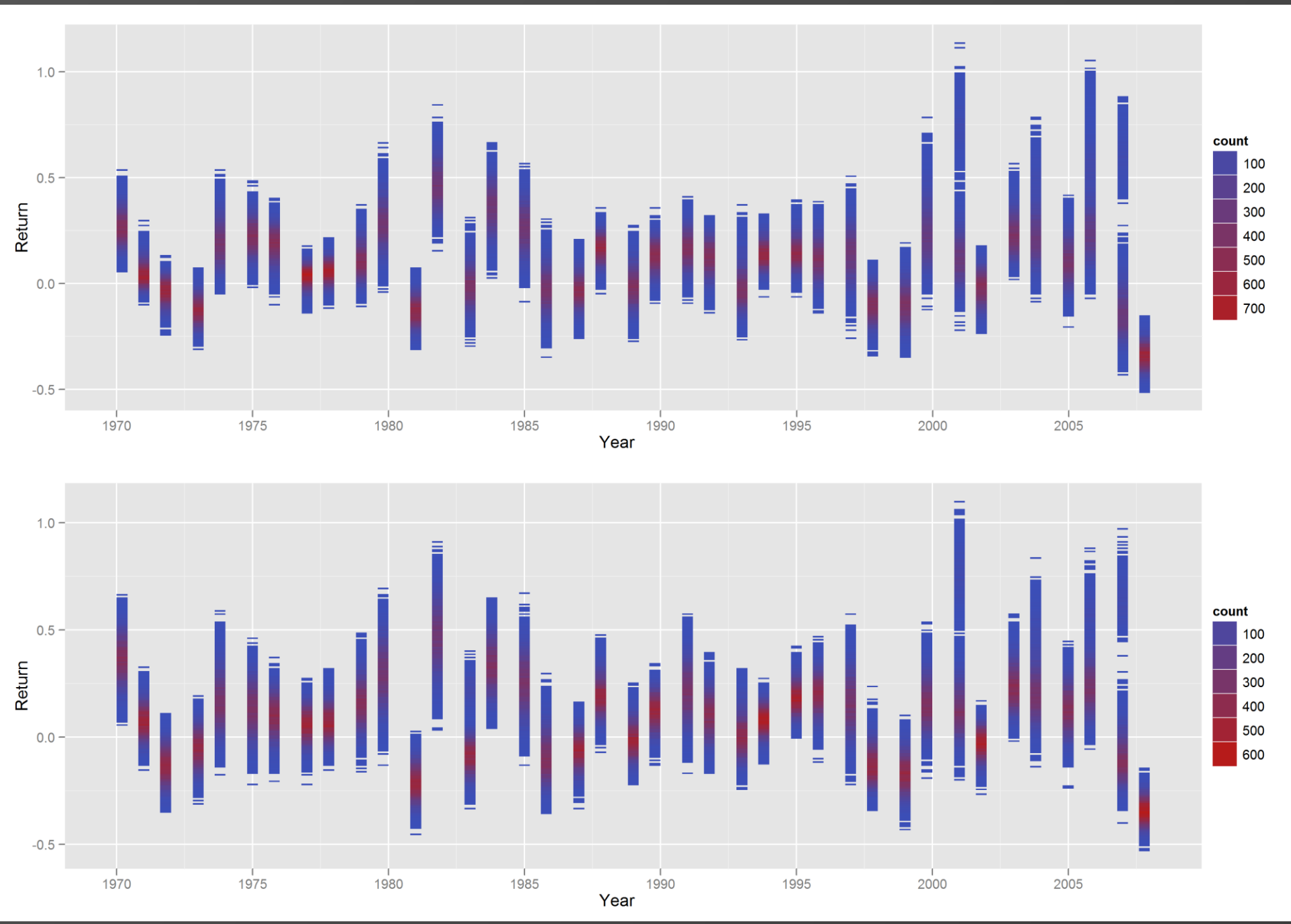
**Figure 1** Distribution of common stock dividend yields in 2006. The bimodality was considered when selecting values of  $D_{max}$

## Considerations

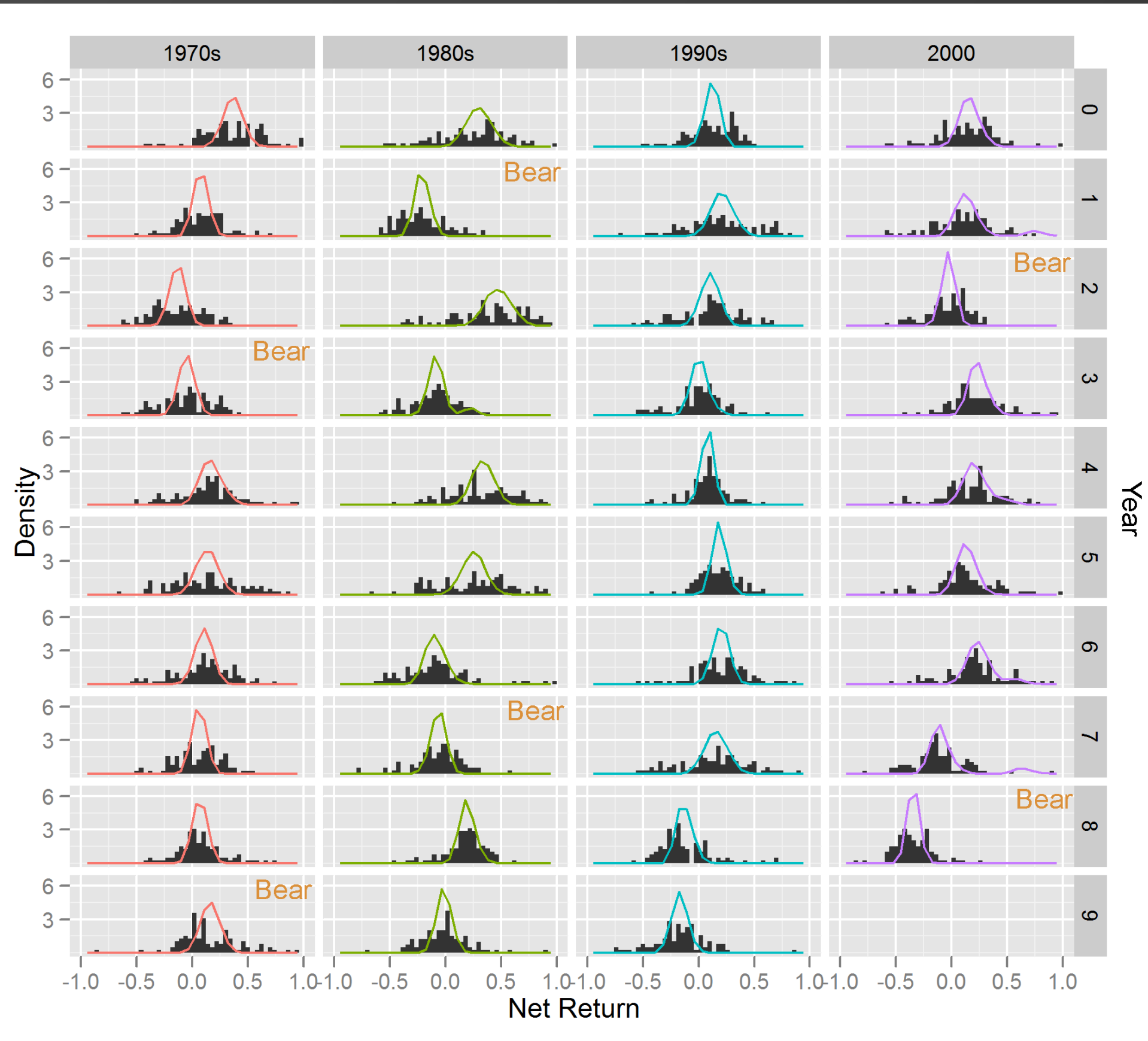
- Taxes on capital gains were not included
- \$7 (not inflation adjusted) fee per trade
- Excess cash not reinvested
- Portfolio construction is lagged by 6 months to account for look ahead bias
- Shares not infinitely divisible
- Odd lots allowed
- Positive P/E ratio
- Above minimum market cap (\$300M)
- Two dividend universes: Dividend yield  $\in$  (0,0.08) or (0,0.045)
- Price  $\in$  (1,5000)

## Portfolio Returns

Ideally, a portfolio construction strategy should create portfolios with a high mean yield and low variance. Portfolios constructed by varying the weighted ranking function and  $D_{max}$  were compared using these two statistics. It was found that, overall, there is a tradeoff between the two – i.e. with higher returns comes higher variance. However, when both are considered as criteria for choosing a strategy, those strategies with more importance placed on P/E ratio tend to perform better.

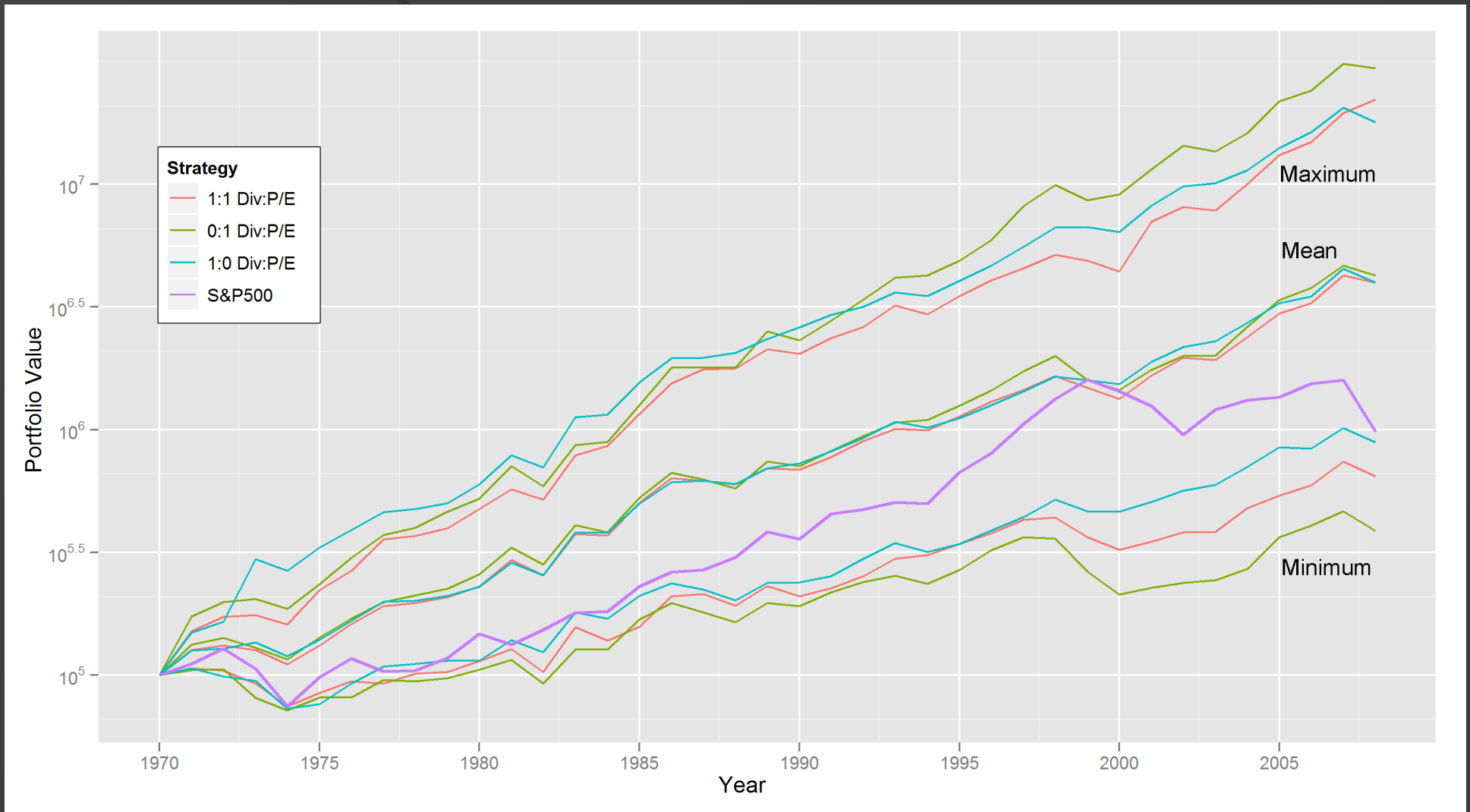


**Figure 2** Distribution of bootstrapped portfolio returns by year, for  $D_{max} = 0.080$  (above) and  $D_{max} = 0.045$  (below). The distribution for  $D_{max} = 0.045$  appears more disperse than for  $D_{max} = 0.08$ .



**Figure 3** Distributions of stock returns from list of top 100 (black) and backtested portfolio returns (curves, coloured by decade), divided by year. Major bear markets (downward trends) are marked.

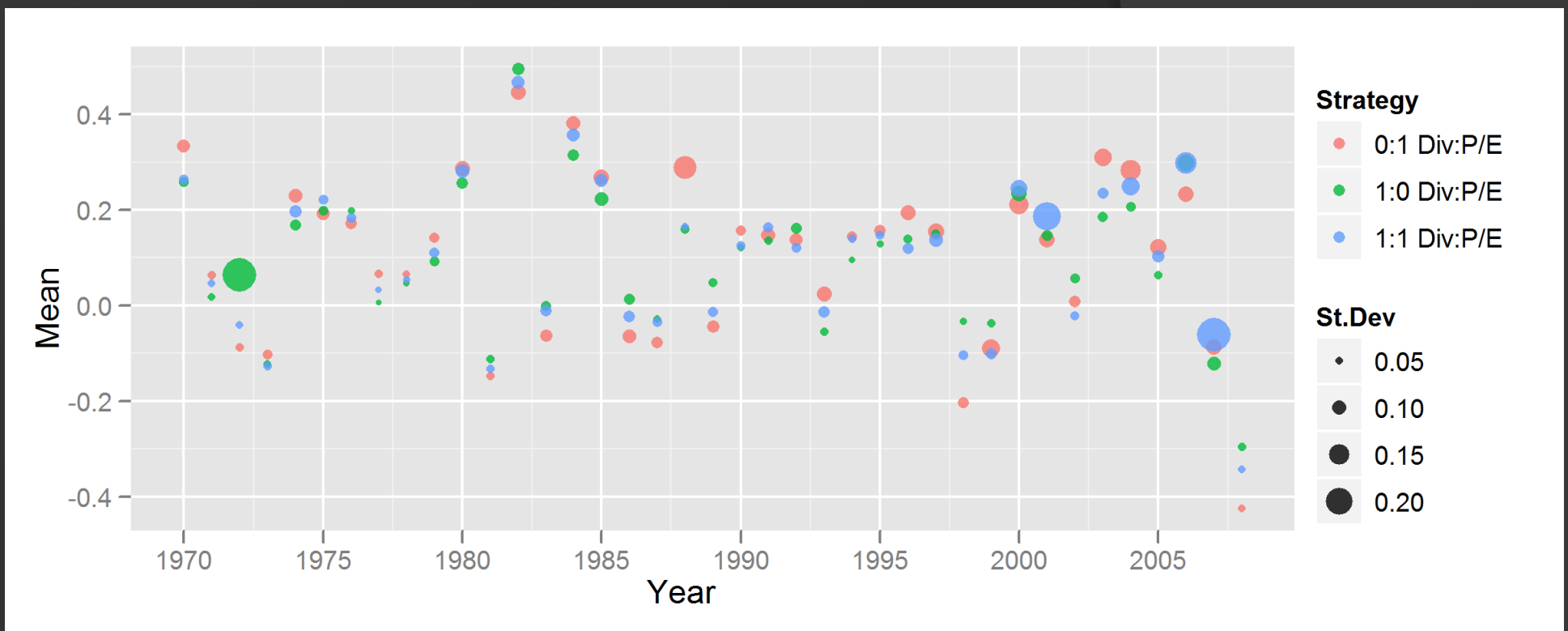
A strong central tendency can be seen in the portfolio returns, regardless of the distribution of returns for the individual equities. It can also be seen (as in 2007) that a small number of outliers among the equity returns can create bimodality in the portfolio returns.



**Figure 4** Mean, maximum, and minimum returns of three weighting strategies with  $D_{max} = 0.08$ , compared to benchmark nominal S&P500 portfolio value. Three strategies have roughly the same mean, which is greater than the S&P500.

	Div and P/E	Div	P/E
Min	3.50%	4.40%	2.20%
Mean	8.20%	8.50%	8.00%
Max	13.40%	12.80%	13.80%
$\sigma$	1.33%	1.12%	1.41%

**Table 1** Summary statistics of average annual returns of the three weighting strategies shown in Figure 3, with  $D_{max} = 0.08$ .



**Figure 5** Plot of mean and standard deviation by strategy. The equal weighted 1:1 strategy seems to have a higher variance indicating higher risk, whereas the dividend strategy has the least variance. The dividend strategy also appears to outperform the other two based on mean return.

## Conclusion

Investing solely based on the dividend yield appears to be the best strategy, outperforming the P/E strategy by 0.5% annually on average, which is considerable considering compounding over 40 years (22% better). The risk associated with this dividend strategy is also better compared to the P/E strategy, with 0.78% less variance per year.

The better  $DIV_{max}$  cutoff was 0.08 since there was less variance associated with the returns. Despite holding these stocks for only a year, the original maxim still holds: a stock's worth is captured in its dividends.

## Resources and Acknowledgements

O'Shaughnessy, J.P. *What Works on Wall Street: A guide to the Best Performing Investment Strategies of All Time*. McGraw-Hill (2005).  
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