

## GOLDBAUM Data Science Report

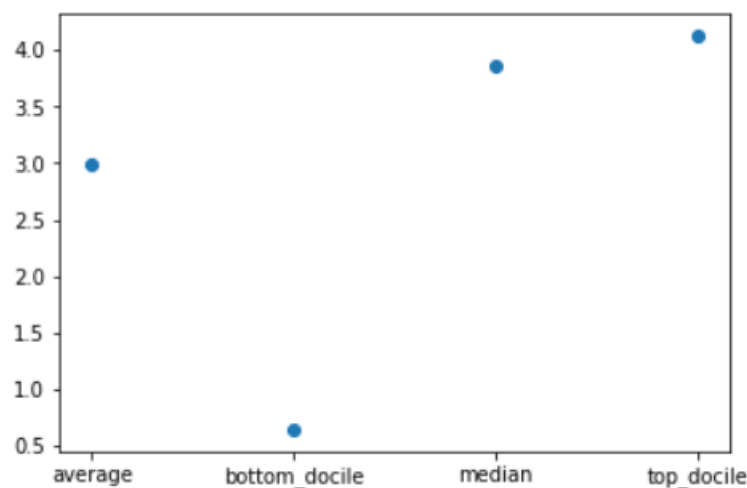
Implemented using Python 3.6 and Jupyter Notebook.

Data was collected for 9 different robo-advisors, obtaining information on the return, risk, assets under management and management fee between 04-2017 and 04-2018. The data was saved in a Pandas DataFrame.

In step 3, the net risk-adjusted return was calculated for each of the robo-advisors. The chosen timeframe is that of the entire dataframe and the periodicity is one year. Below is an image of the initial dataframe, with the additional column showing net risk-adjusted returns.

	Return (%)	Standard dev (%)	Management fee (%)	AUM (\$ billions)	Net risk-adjusted return
Robo-advisor					
FutureAdvisor	8.66	14.20	0.50	1.00	0.574648
Schwab	16.68	4.24	0.00	12.40	3.933962
Wealthfront	8.06	11.91	0.25	4.70	0.655751
Betterment	16.15	3.87	0.25	7.00	4.108527
Vanguard	16.10	3.77	0.30	51.00	4.190981
Personal Capital	13.97	4.32	0.70	2.90	3.071759
Acorns	13.72	5.34	0.25	0.26	2.522472
SigFig	16.99	4.19	0.25	0.12	3.995227
WiseBanyan	15.64	4.06	0.00	101.00	3.852217

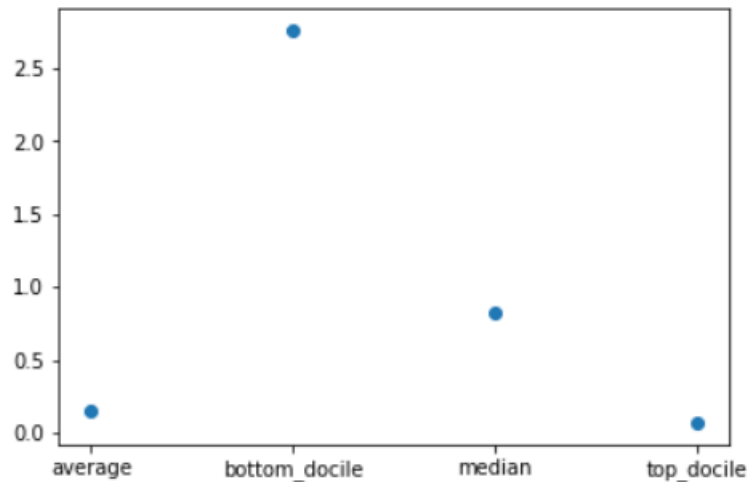
In step 4, the bottom and top dociles, mean and median of net risk-adjusted return were calculated. These were then plotted in a graph, which can be seen below.



Most obvious from this graph is the fact that there is a big difference between the bottom docile and the average, which means that the lowest values of net-adjusted returns are significantly far from the majority of the values. Additionally, the median is very close to the top docile, which means that the second half of the data consists of very high values. The fact that the average is lower than the

median suggests that the data is unevenly distributed, and that the lower half of the values has a higher range than that of the top half.

In step 5, these measurements were plotted against the equivalent AUMs. The graph can be seen below.



The graph shows a descending rate, which means that the risk-adjusted returns do not grow proportionately with the AUM. It would be expected that robo-advisors with higher AUM would have higher percentage returns, and so the rate between returns and AUM would be constant. However, it is clear from this graph that the advisors with small AUM obtain similar percentage returns to the advisors with high AUMs. Therefore, performance does not increase with portfolio size. Additionally, the fact that the average is very close to the top docile means that many advisors have high AUMs, which bring down the value of the return/AUM ratio.

Finally, it can be concluded that there are several robo-advisors with a longer history and bigger portfolio, and a small number of new-comers. The performance of robo-advisors does not increase with portfolio size, with percentage returns being somewhat similar between all. Of course, being a percentage return, it implies that the profits of robo-advisors with larger portfolios are still higher than those with small portfolios.