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APPLICATION OF MONTE CARLO TO STUDY SURVIVORSHIP BIAS IN PORTFOLIO MANAGEMENT

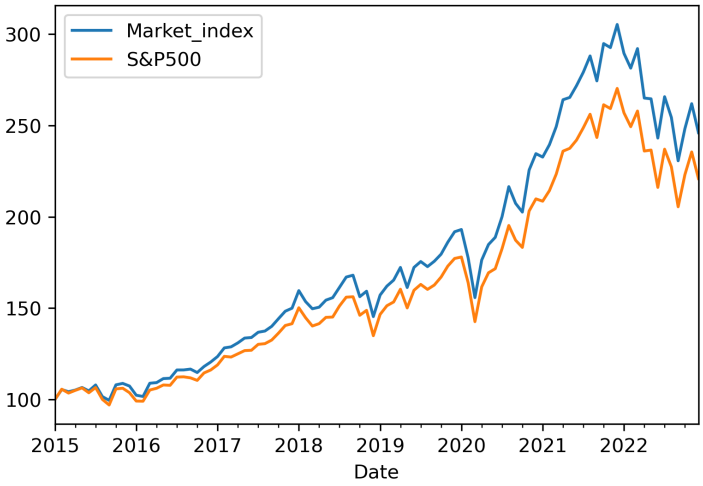
"Actively vs passively managed funds" debate is here for a while. SPIVA scorecard indicates that in 2001-2022 period from 45% to 87% of actively managed investment funds were underperforming Large-Cap index based on annual results.[1] Still, actively managed funds promote their returns as high and robust. Hence, average retail investor is faced with a question: Can "smart guys" really beat the market consistently?

One of the problems is that measurement of the ability of portfolio managers (as a whole) is tricky. Elton and colleagues argue that ignoring the effect of survivorship bias can overstate funds' true performance. They use data on merged US mutual funds to further quantify this effect.[2] Carpenter and Lynch simulate funds' alphas based on different generating processes.[3] They also reach the conclusion that attrition effect should be accounted for in research. So we can define survivorship bias risk as a chance of making erroneous research conclusions or investment decisions as a result of survivorship bias.

Taleb simplifies the setting to show how survivorship bias can adversely affect investors' decision making.[4] He assumes 50% probability of fund making money (no strategy) and by basic math shows that on 5 year horizon 3% of funds (managers) will make money by pure chance, but will promote it as their ability. This work takes Taleb's example and tries to improve its realism using historical market data for large cap stocks. The goal is to try to simulate fund managers' performance, assuming fixed universe of assets. Then make conclusions about chances of randomly "beating the market" T years in a row.

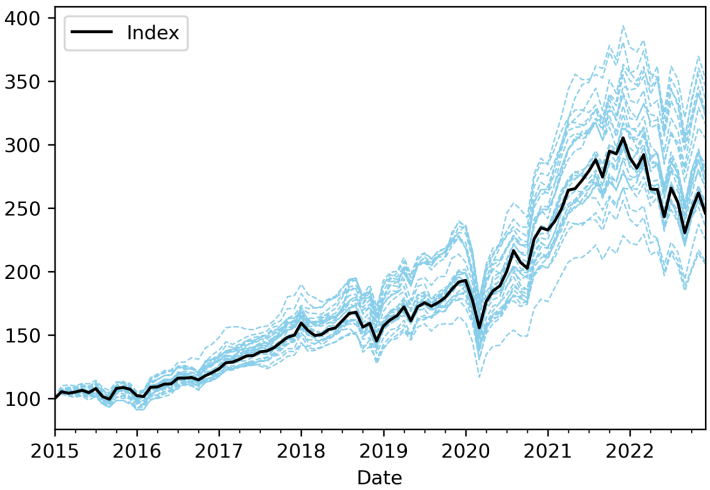
The first step is to fix the universe of assets and compute market index for this universe. The time period under study is 2015-2022, so acceptable approach would be to form the universe from constituents of S&P500 index, that were present in the index during this whole period. These are 479 shares of large-cap companies. Based on year-end 2022 capitalization of companies and their monthly returns from 2015 to 2022 it is possible to reverse engineer their market caps for the whole period and, thus, their weights in our index. Comparison of the custom index to S&P500 market data is pictured on Graph 1.

Next step is to construct random performing managers. This can be accomplished by simulating asset weights for each manager. Then, applying these weights to assets' returns will give a financial performance of the manager.



Graph 1. Custom-made market index vs S&P500 (2015Y - 100)

Straightforward way to get random asset weights is to simulate for each manager at every point in time N (N – number of assets) uniformly distributed random numbers and divide each by their sum. This approach, however, leads to unrealistically balanced portfolios (even more balanced then market index). More realistic portfolios are constructed by simulating Dirichlet distribution. Parameter α controls for "balance" in the portfolio, for lower α portfolios are more concentrated. Also, weights of assets sum to one by property of this distribution. Performance of some simulated fund managers is compared to Market index on Graph 2.



Graph 2. Performance of some simulated managers vs Market index

After simulating 10000 portfolio managers' performance on a monthly basis, it is possible to apply some survivorship criteria to see how material is the chance of survival for a random manager. I explore the simple one: if the manager's annual

return is higher than market's, he survives, in the opposite case he loses the job. So monthly returns were aggregated and compared to the index. Results are summarized in Table 1.

Table 1. Share of survived managers during the period

Year	% of "managers" who beat the index (survived)
2015	33%
2016	89%
2017	60%
2018	40%
2019	67%
2020	25%
2021	63%
2022	98%

It can be seen that on a 5-year horizon from 2.5% to 4.5% of random managers survived and beat the market, which is close to a simple Bernoulli model used by Taleb. Watching them from the end of this period, investor may be tempted to attribute this success to the skills of the managers, when in fact he does not see 97% of managers that employed the same strategy and went bust. On the 8-year horizon probability of survival is 0.6% compared to 0.4% by Bernoulli model.

This work has shown by applying Monte Carlo simulation that indeed for a portfolio manager employing a random investment strategy probability of becoming a "star manager" is considerable. Based on market data, this probability is close to that obtained by simple Bernoulli model. The model developed in this work is of use for demonstration of adverse effects of survivorship bias on decision making. Still, model can be improved by including risk characteristics into the model, applying more realistic survivorship criteria and making random portfolio development more realistic.

References

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