BACKEND BENCHMARKING PRESENTS:

The Robo Ranking™

EDITION 2

Winter 2019 Edition

Bringing Transparency to Robo Investing

We are excited to publish our second edition of *The Robo Ranking™*. *The Robo Ranking™* is the only comprehensive ranking of robo advisors that includes not only the features and services, but also the performance of robo advisors. Robo advisors have taken the advice industry by storm, with the larger independent providers continuing to show strong growth, and robo advice technology being adopted across banks, brokerages, and other traditional advice firms. Robo advice providers are proving attractive to individual investors in large part due to their significantly lower minimums and costs. Since these products are relatively new to the investment landscape, there is little information available to investors. Here at Backend Benchmarking, our goal is to bring transparency to the robo advice industry to empower investors to seek the best products and services. The *The Robo Ranking™* goes well beyond performance and grades the robos across 45 specific metrics. We scored each robo on various high-level categories, such as features, financial planning, customer experience, access to live advisors, transparency and conflicts of interest, size and tenure, account minimums, costs, and performance. Each metric where we grade the robos is specific and unambiguous.

The Executive Summary

We believe *The Robo Ranking*™ is a powerful tool to help those seeking a digital advice product find the best providers. Although we rank each robo with an overall score, we also acknowledge the differences in individual investors and their situations. To aid different types of investors find a product that is right for them, we created sub-rankings to help investors understand areas where different products excel. Once an investor has identified their needs, the sub-rankings can help them select a provider that stands out in the areas that are most important to them.

Performance is partly based on Backend Benchmarking's innovative method to compare globally diversified portfolios called Normalized Benchmarking. A methodology of Normalized Benchmarking can be found on our website. The details of how we created the scores and ranking can be found on our website and at the back of this report. This edition, we have made some updates to how we score the ranking. For example, we now include weighted average expense ratios and management fees as a single metric instead of two separate ones, and have further defined the specific features we look for when scoring financial planning. Our Normalized Benchmarking method has also been updated. The Normalized Benchmark is now dynamic, and changes to match the equity/fixed income ratio of the portfolio when we see significant changes to portfolio allocations resulting from trading activity. We also have included a 0.30% management fee in the benchmark to better reflect the performance of a managed portfolio.

This edition also includes an interview with SigFig CEO, Mike Sha. We have also introduced three providers where we now have a two year portfolio history. Fidelity Go, Ellevest, and TD Ameritrade are now ranked, in addition to the 10 providers from the last edition. We look forward to continuing to provide in depth analysis, and are proud to publish the Winter 2019 Edition of *The Robo Ranking*™.

Robo Ranking

Best Overall Robo

Winner: Fidelity Go
Runner-Up: SigFig

Fidelity Go is new to this edition of the ranking and has achieved the top score. Fidelity Go's performance notched the top spot when measuring their return over the Normalized Benchmark and their Sharpe ratio. Strong performance, combined with high-scoring qualitative features, propelled them to the top spot.

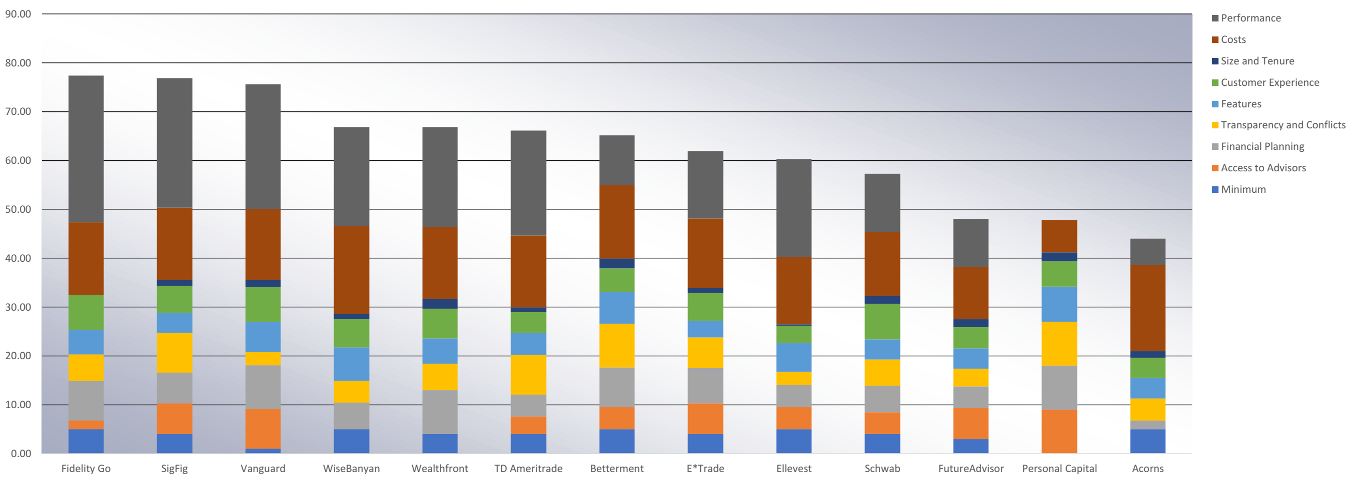
Fidelity holds all proprietary funds that they introduced earlier in 2018. These funds carry no expense ratio, making their 0.35% management fee the full cost of the service. For this edition of *The Robo Ranking*™, we adjusted how we score costs, and now combine the weighted average expense ratio of the non-cash funds in our account with the management fee. Although 0.35% is a higher management fee than some other robos, when considering combined management fees and expense ratios, Fidelity Go is right on par with other low-cost providers. Although holding all proprietary funds decreased their transparency and conflicts of interest score, we believe offering a product that has the all-in costs as a single, clear, management fee makes it easy for investors to understand what they will pay.

Fidelity Go also has quality financial planning tools, with modules for different types of spending goals, like college planning or charitable giving. While the planning modules are robust—for example, helping users estimate projected education expenses—it considers goals independently and does not produce an integrated single financial plan. Additionally, the planning features are not well integrated with the target account balances that are created at onboarding.

Fidelity Go's website has many features and capabilities and is easy to use overall. One feature that is common among robo advisors, but Fidelity does not offer, is automated tax-loss harvesting. For those that have trouble using the website or completing tasks, they do offer live phone support and a chat option, but support representatives are not advisors. Overall, Fidelity's platform and performance are strong and they are a great choice for those seeking a low-cost, low-minimum, strongly performing, robo advisor.

We awarded SigFig the runner up for Best Overall Robo, moving up from third place in our last ranking. Their performance based on their return above the Normalized Benchmark and Sharpe ratio came in second only to Fidelity Go. SigFig has a straightforward and simple interface and does a nice job presenting information to the user. Their retirement planner is relatively basic, but has advanced settings for those that want to dig into the details, and is definitely capable of helping users create a functional retirement plan. For when automated advice falls short, all SigFig clients with $10,000 in managed assets have access to live advisors, which stands out, as they only require a $2,000 minimum and charge a 0.25% fee on managed assets over $10,000. Other providers often charge more or require larger minimums before gaining access to a live advisor. They provide aggregation of outside accounts like other robos, but their system goes a step further than just an aggregate view by providing advice and identifying potential problems of outside portfolios. SigFig does have automated tax-loss harvesting, but those looking for multiple portfolio themes should look elsewhere. With live advisors, a simple and intuitive interface, and strong portfolio performance, SigFig is a compelling choice when considering a robo advice provider.

Robo Ranking



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Robo Ranking

Robo Name	Minimum	Access to Advisors	Financial Planning	Transparency and Conflicts	Features	Customer Experience	Size and Tenure	Costs	Performance	Total
Fidelity Go	5.00	1.80	8.10	5.40	5.04	7.09	0.08	14.87	30.00	77.38
SigFig	4.00	6.30	6.30	8.10	4.14	5.51	1.20	14.81	26.53	76.88
Vanguard	1.00	8.10	9.00	2.70	6.12	7.12	1.50	14.49	25.61	75.64
WiseBanyan	5.00	0.00	5.40	4.50	6.84	5.76	1.12	17.98	20.27	66.86
Wealthfront	4.00	0.00	9.00	5.40	5.22	6.04	2.00	14.74	20.43	66.83
TD Ameritrade	4.00	3.60	4.50	8.10	4.50	4.24	1.00	14.74	21.48	66.17
Betterment	5.00	4.50	8.10	9.00	6.45	4.90	2.00	14.99	10.22	65.16
E*Trade	4.00	6.30	7.20	6.30	3.42	5.67	1.00	14.24	13.83	61.97
Ellevest	5.00	4.50	4.50	2.70	5.89	3.53	0.37	13.79	20.04	60.32
Schwab	4.00	4.50	5.40	5.40	4.10	7.29	1.58	13.02	11.99	57.29
FutureAdvisor	3.00	6.30	4.50	3.60	4.14	4.35	1.60	10.71	9.85	48.05
Personal Capital	0.00	9.00	9.00	9.00	7.20	5.19	1.80	6.61	0.00	47.80
Acorns	5.00	0.00	1.80	4.50	4.14	4.18	1.35	17.70	5.32	43.99

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Sub-Ranking Winners

Best Robo for Performance at a Low Cost

Winner: Fidelity Go
Runner-Up: SigFig
Honorable Mention: WiseBanyan

This edition, we awarded our Best Robo for Performance at a Low Cost to the best performing robos over the two-year period, Fidelity Go and SigFig. Although Fidelity Go's management fee is 0.35%, higher than Vanguard at 0.30% and Betterment and Wealthfront at 0.25%, their portfolios hold Fidelity funds that carry no expense ratios. Vanguard, for example, ranked third in performance, and although on the surface their 0.30% management fee is lower than Fidelity's, the weighted average expense ratio of the funds in our account is 0.08%, which makes their all-in cost 0.38%, higher than Fidelity's 0.35% all-in cost.

The runner-up in this category is SigFig. They have a low 0.25% fee, on top of managing the first $10,000 of managed assets for free. Their performance has been strong over the past two years and makes them a compelling option for those seeking performance at a low cost.

We have awarded WiseBanyan an honorable mention in this category. They performed well over the past two years. They offer their most basic investment management of taxable accounts for free. They provide add-on packages, like tax-loss harvesting, at an additional cost, and they recently started requiring retirement accounts to turn on their tax-efficiency package at a cost. Even with tax-loss harvesting turned on, their fee comes out to around 0.24% a year, which is low. Still, they will manage a taxable account for free, and unlike Schwab, who also will forego a management fee at the digital-only level, WiseBanyan does not mandate a high cash balance.

Best Robo for Complex Financial Planning Needs

Winner: Personal Capital
Runner-Up: Vanguard

For those with complex financial planning needs, we have selected the two robos that scored full points in the financial planning section, in addition to providing live advisors to all of their clients. Personal Capital not only has a very strong digital planning tool, they also make live planners available to their clients. Vanguard does not have nearly as strong of a digital planner, but their advisors are capable of working directly with clients to create a comprehensive plan.

Personal Capital's robust digital planner helped them secure the top spot in this category. By integrating saving, spending, and other life events into a single timeline, Personal Capital stands out against many other tools that can only model a single goal at a time. There are 10 spending goal options that include one-time expenses and ongoing spending needs. The planner can also incorporate multiple income streams, like those from an annuity, pension, or rental income, as well as one-time windfall events, like downsizing a home or inheriting money. The planner is effective in combining multiple income streams, savings goals, and spending events into an integrated financial plan. Additionally, users can create multiple different plans, allowing investors to compare how saving and spending decisions will affect the viability of their goals. Personal Capital also released a tool called Retirement Paycheck in 2018, which models and advises clients on how to draw down their assets in a tax-efficient way.

In addition to their planning tool, all Personal Capital clients have access to live advisors who can help clients work through the complexities of building a comprehensive plan.

One downside to Personal Capital's high-quality service is their fee. Starting at 0.89%, Personal Capital's management fee is one of the highest among the robo advisors that we cover.

Vanguard lacks the robust digital tools offered by Personal Capital, but through their advisory team they are capable of building comprehensive plans. Working with an advisor, users can build multiple goals, model multiple income streams, and receive a complete illustration. Although the digital experience and website at Vanguard is outpaced by other providers, working directly with an advisor can help users make sure they are covering the important aspects of their financial situation. Previously, Vanguard allowed for the manual input of outside accounts, but in 2018 they introduced an automatic aggregation service, eliminating the need for manual updates. Aggregating outside accounts also allows Vanguard clients to incorporate multiple accounts across institutions into a more complex and extensive picture. Vanguard is a good option for those looking for a more low-tech but human experience while keeping costs low.

Best Robo for Digital Financial Planning

Winner: Wealthfront
Runner-Up: Personal Capital
Honorable Mention: Betterment

Overall, we have found that independent robos typically offer the most compelling digital experiences. When it comes to the best digital financial planning tools, Personal Capital and Wealthfront lead the pack, as they allow users to build complex multi-goal plans and view their interaction in a single unified plan. They let users link their external accounts to allow for a comprehensive view of their financial picture. Additionally, with Wealthfront's October 2018 announcement, both robos offer their digital planning features for free.

Wealthfront lets users model five different scenarios: retirement, paying for college, buying a home, income windfalls, and taking time off work to travel. For each goal, Wealthfront built a robust tool that guides users through building a reachable goal. For example, their home buying goal suggests home prices one can afford taking into account current rent, income, and location of a potential purchase. Once a goal has been set, it is plotted along the net worth timeline.

Personal Capital can model a very broad set of goals. They can take into account seven different types of income events and ten different types of spending goals within their planner. However, these income and spending events are primarily driven by user input with little to no automated help provided by Personal Capital. For example, looking at the college savings planner, there is no ability to plan for a future child, no consideration for financial aid based on one's income, and college costs are assumed to be constant at the user's inputted value. In contrast, Wealthfront's tool allows planning for current and potential future children, looks at current college costs at a selected university, and projects the future cost factoring in inflation, and determines likely financial aid based on one's income. Therefore, while Personal Capital has greater breadth of scenarios, each of Wealthfront's tools are more data-driven and developed, guiding users through the planning process. For this reason, we gave the edge to Wealthfront as the Best Robo for Digital Financial Planning.

Betterment deserves an honorable mention in this category. They give users the ability to build multiple financial goals, which factor in data from linked outside accounts. With this information, they suggest various changes to achieve each of these goals. However, in our minds, there are two things holding Betterment back behind the likes of Personal Capital and Wealthfront: One, there is no way to see a unified plan that takes into account the interactions of each independent goal, and two, these planning tools are only available to paying clients.

Best Robo for First-Time Investors

Winner: Betterment
Runner-Up: Acorns

Betterment takes the mantle for Best Robo for First-Time Investors. Their digital-only product is low cost and has a zero-dollar minimum, making it an attractive choice for a first-time investor. With an intuitive, single-goal financial planner, Betterment makes it easy for new investors to understand decisions that will lead to greater financial success. Additionally, with the rollout of a la carte pricing for personal consultation with a financial planner, users can get professional help as they see fit whenever their financial situation changes. Finally, as a client's wealth grows, so do their planning and financial management needs. With Betterment, they can upgrade to premium to receive help navigating through these challenges without changing advisors.

While Acorns may not have scored well in our ranking, their ability to attract young, low-asset clients is unparalleled among the advisors we cover. They encourage saving and investing through a unique feature called Round-Ups, where any time a linked debit or credit card is used, Acorns invests the difference between the purchase price and the nearest dollar amount. While this only amounts to small sums, it builds a habit of saving and investing regularly. With Acorns' simple, mobile-first platform, they eliminate the mental barriers to investing by focusing more on the act of saving than on teaching the nuances of portfolio construction to their users. This method has proven to be successful at attracting users; Acorns leads all robos in the number of users by a large margin.

While all of these things are great for new investors, there is one thing we have to point out about Acorns: Users pay between $1 and $3 per month depending on which features they select. While this may not seem like a lot, users typically have low account balances, so this fee can represent a significant portion of the overall account value. For example, a client with a $100 account is effectively paying a 12% management fee, assuming they are subscribed to the $1 monthly plan. Users need to be aware of the high relative cost if they only have a small amount of money being managed.

Best Robo from an Incumbent Financial Institution

Winner: Fidelity Go
Runner-Up: Vanguard

We have awarded the Best Robo from an Incumbent Financial Institution to Fidelity Go. We have found in our analysis that the best online experiences are provided by independent robos, so those seeking the best tech experience may want to seek out one of the independent providers. That said, for those who would rather entrust their money to established names in the financial services space, Fidelity and Vanguard have quality products.

Fidelity Go has robust feature sets, good online planners, and great performance. Their offering comes with the ability to seek support from live representatives, either through chat or over the phone, but those representatives are limited in the advice they can deliver. Vanguard, on the other hand, has a relatively low-tech experience but provides access to live advisors. Vanguard clients with more than $500k in assets get a dedicated advisor, and those with less work with a team of advisors. Human advice at 0.30% management fee makes Vanguard a quality choice. Both Fidelity and Vanguard have financial planning, are strong performers, and create quality low-cost portfolios, and this, combined with their established reputations as pillars in the financial services industry, brought them to the top of this sub-ranking.

Robo Ranking Facts

	2-Year Annualized Return	Return Above/Below Normalized Benchmark	Sharpe Ratio	Account Minimum	Advisory Fee	Average Weighted Expense Ratio
Acorns[1]	2.94%	-1.76%	0.24	No minimum	$1/month for Acorns Core; $2/month when adding Acorns Later for Retirement accounts. For balances above $1 million, $100/month per $1 million in AUM	0.10%
Betterment[15]	3.39%	-1.25%	0.29	Digital: No minimum; Premium: $100,000	Digital: 0.25%; Premium: 0.40% (unlimited chat and calls with advisor)	0.09%
E*Trade (ETF)[21]	3.54%	-0.90%	0.33	$5,000	0.30% (promo – fee waived for first year)	0.10%
Ellevest[15]	4.15%	-0.56%	0.43	Digital: No minimum; Premium: $50,000	Digital: 0.25%; Premium: 0.50% (access to live advisors and executive coaches)	0.11%
Fidelity Go[7]	4.97%	0.49%	0.53	No Minimum	0.35% annually; no expense ratios on underlying funds	0.00%
FutureAdvisor[3]	3.10%	-1.32%	0.29	$10,000	0.50% annually	0.14%
Personal Capital[4]	2.64%	-2.35%	0.19	$100,000	0.89% annually for the first $1 million; lower at different tiers over $1 million	0.12%
Schwab[5]	3.59%	-1.25%	0.33	Intelligent Portfolio: $5,000; Intelligent Advisory: $25,000	Intelligent Portfolio: No fee (digital only); Intelligent Advisory: 0.28% annually (Access to live advisors) capped at $3,600 per year	0.21%
SigFig[6]	4.77%	0.25%	0.48	$2,000	No fee for the first $10k; 0.25% annually for balance over $10k	0.08%
TD Ameritrade[10]	4.52%	-0.12%	0.41	Essential Portfolios: $5,000; Selective Portfolios: $25,000	Essential Portfolios: 0.30% annually; Selective Portfolios: tiered at a higher fee level depending on account balance and portfolio selected	0.06%
Vanguard[4,A]	4.60%	0.16%	0.47	$50,000	0.30% annually for the first $5 million; lower at different tiers over $5 million	0.08%
Wealthfront[22,B]	4.32%	-0.32%	0.41	$500	0.25% annually	0.11%
WiseBanyan[8]	4.25%	-0.35%	0.41	No minimum	No Fee for basic package; add-on packages, such as tax loss harvesting, come at additional cost	0.10%

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This quarter, we spoke with Mike Sha, CEO and co-founder of SigFig, a robo advice provider that has found significant success by partnering with banks and other financial institutions. SigFig has partnered with industry giants like Wells Fargo and UBS to integrate their technology into their existing platforms. Mike provided insight into the B2B robo advice space and helped us understand why these solutions are proving attractive to existing advice providers.

SigFig began as Wikinvest, a website designed to provide information for individual investors, that was popular with self-directed investors. During his time at Wikinvest, he discovered three main insights. As Mike puts it, the first was "investing is a chore for most people;" the second was, "a vast majority of people out there who have some form of investments…generally speaking, have unhealthy portfolios, or at least portfolios that could be meaningfully tuned up."; and the third was, "... the traditional investment advice industry tends to focus on people who have a lot of money." These three basic insights served as the foundation, not just for SigFig, but for the introduction and rapid growth of robo advisors as a whole.

The advice gap that traditional advisors have created by under-serving large segments of the population, who have wealth, but often not enough to be considered attractive wealth management clients, left an opportunity for robo advisors to find their place in the market. The technologies and success of direct-to-consumer independent robo advice providers have attracted the attention of incumbent financial institutions, and we have seen rapid adoption of digital advice products offered by existing advice providers. Schwab and Vanguard were early adopters, but have since been followed by Wells Fargo, Merrill Lynch, TD Ameritrade, Fidelity, US Bank, and UBS, to name a few, with other major players expected to launch products in coming months.

Early on, SigFig recognized a need for the technology, innovation, and expertise of a company with domain proficiency. As Mike said, "... a vast majority of financial institutions who have lots of customers already, and have an opportunity to serve those customers, are, generally speaking, not strong in technology, user experience, design, and product management, the kind of things that young fintech companies like ours [excel at]." SigFig has found success partnering with large institutions to provide them an opportunity to leverage their existing relationships with customers to introduce professionally managed portfolios and digital advice.

An important component of why banks are finding digital advice solutions attractive is they have realized that many of their own customers are falling into the advice gap, and there are opportunities to provide more services to their existing clients. Many banks either do not offer investment advice solutions or their wealth management departments are focused on only the wealthiest segments of their banking clients. Introducing new products to existing clients is far easier than bringing on new-to-firm clients. Mike shared with us that, "Most firms today are thinking about the usage of our technology to serve a customer base that they have already acquired."

This concept highlights some of the largest hurdles for independent, direct-to-consumer robo products. A company like Wealthfront has a tougher battle acquiring customers because each new client needs to be a first-time Wealthfront client. A company like Wells Fargo can build a digital advice product that is successful without ever needing to attract clients who do not already have a Wells Fargo relationship. We believe this is why there has been a significant slowdown of new independent robo advice product launches, while there is still great momentum in banks and other existing financial institutions launching robo advice products. Acquiring new-to-firm clients is significantly more difficult and expensive than cross-selling.

While SigFig has partnered with bank clients looking to offer scalable wealth solutions to the masses, they have also attracted UBS, which is traditionally a high-net worth and ultra-high-net worth management firm. Technologies that power robo advice firms can not only be used to create a scalable model for lower asset clients, but also improve processes and efficiency at traditional advice firms. Many traditional advice firms have fallen behind in technology. At many firms, the process of opening an account may take up half of a client meeting, as new clients work through paper applications. We believe that some of the most impactful aspects of robo advice products in the advice industry are automation, process streamlining, and client communication. Integrating technology into existing platforms of traditional advisors can pay great dividends in the efficiency and level of services offered. Price compression is a powerful force in financial advice, and one that is not going away. Advisors will need to learn to serve more clients with a higher level of service to be competitive. This environment is an opportunity for SigFig to help traditional advisors modernize their firms and business practices.

Mike provided us with great insight into the B2B robo business space. After our discussion, we are more confident than ever that an increasing number of consumers will be presented with digital advice products. Since the 2008 crash, the robo advice industry has been largely focused on the independent pioneers of robo technologies. As products and the market mature, the next wave of robo advice will belong to the banks, discount brokers, and broker-dealers. No longer will investors have to seek out a robo advice provider, rather they will be introduced to them where they bank, borrow, or trade. This movement is already well underway, but is far from over.

Robo Ranking Methodology

How We Rank the Robos

The robo advisors are ranked on a comprehensive set of criteria. The final robo score is made up of a qualitative review of their services, platform, company, and features, as well as a quantitative score based primarily on the costs and performance of the portfolio. A small portion of the quantitative score is based on the size and tenure of the robo advice product. When scoring the qualitative aspect of the service, we look at six main criteria: financial planning, user interface and customer experience, product features, access to live advisors, transparency and conflicts of interest, and account minimums.

Overall, in this issue of *The Robo Ranking*™, we re-allocated points in several categories to give more points to robo advisors that provide greater transparency and functionality to users within their base product.

Below, we give examples of what earned robos points in each section.

Financial Planning: Here we graded the platforms on the quality of financial planning services offered. Robos that allowed users to build or create single or multi-goal financial plans were awarded points. Other financial planning tool features that earned points were those that allowed for "what if" scenarios, helped users calculate retirement spending needs, including social security benefit estimates, allowed for the inclusion of pension or other retirement income, and offered suggestions on appropriate monthly saving goals. In this issue of the rankings, points were awarded if their planning tools had specific functionality. For example, if the single-goal planning tool could: One, model future account values or spending; two, accept a user input of an account value or spending goal; and three, show either a likelihood of success or changes, then all points were awarded. If only some of these features were present, then partial points were awarded.

User Interface and Customer Experience: Here we evaluated the user interface and the digital customer experience. We looked at the ease of getting to basic account information and general accessibility of the site. We measured the number of clicks required to access basic account and portfolio information, and used third-party software to produce an "accessibility score." Points were also awarded to platforms that had good content and articles on basic personal finance and investing topics. During onboarding, we looked to see if the online process took less than 30 minutes from start to account opening, and if the onboarding questionnaire took into account a user's comfort with investing and inquired or mentioned whether the user has an emergency fund. We also scored robos that had the ability to aggregate held-away accounts for a holistic financial picture. Availability of live chat options and mobile apps also helped robos score higher in this category.

Product Features: Robos were awarded points for different types of features. Tax-loss harvesting, tax efficiency, automatic deposits, ability to trade fractional shares, rebalancing, types of accounts offered, access to impact or other themed portfolios, and the ability of a robo to customize a portfolio to a specific customer situation were the features we looked for in this category. We also included a field for unique and additive features that were not explicit in our scoring. This unique and additive features criteria was a small portion of the overall features score.

Transparency and Conflicts of Interest: In this category, we looked for things like whether or not a user could easily compare their portfolio to relevant benchmarks to help them understand performance. We also awarded points for platforms that made their models available before account opening, and further points if they also published performance of their models to prospective customers. Availability of white papers and other information on how portfolios are constructed were also awarded points. We also awarded points to those portfolios that did not rely entirely on proprietary products or chose no proprietary products when constructing their portfolios.

Access to Live Advisors: Robos with access to live advisors, or the ability to upgrade to a product that has live advisors, earned points. Robos earned more points if there was a dedicated live advisor option, if they required their advisors to hold CFPs, and if live advisors were made available to all service levels. Partial points were awarded to firms that had products or programs with live advisors if those programs were not part of the digital advice offering. In this issue of *The Robo Ranking™*, more points were awarded to robo advisors that made live advisors available for no additional cost at their lowest service level.

Account Minimum: Robos earned points for having lower minimums. This section was weighted less than the other five categories above.

Costs: New to this *Robo Ranking™*, we scored costs on the sum of the management fee and average weighted expense ratio rather than scoring these two components separately. This method better reflects the true cost incurred by clients. Additionally, we consider a cash allocation as a cost if the cash holding is earning less than 0.95% APY. If a cash position was earning 0.95% or more, robos received full points in this section. Robos with cash positions that are earning less than 0.95% received less than full points in this category. The cash allocation had a much smaller impact than management fees and weighted expense ratios.

Performance: We used two metrics to grade a robo's performance. The first was Sharpe ratio, which is a measure of risk-adjusted returns. The second was their return above/below the Normalized Benchmark. This measurement method reduces the impact of different equity/bond allocations in the portfolio. The method of using a Normalized Benchmark was created by the team at *The Robo Ranking*™ and is explained in detail in the Normalized Benchmarking section on the website.

Size and Tenure: This score is based on the AUM and age of the robo advice products. Large amounts of AUM and older products are less likely to be discontinued in the future, forcing a client to change providers or products, which can be disadvantageous to the client. Robos that do not publish their AUM specific to the robo advice product only received the points available for the age of the robo. We encourage robo advisors and their parent companies to release AUM data for their different products in the interest of transparency to the investor.

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DISCLOSURES:

[1] These accounts were funded with more than the minimum amount required to establish an account. Had the accounts been funded with more assets, they would be charged a flat dollar fee up to $1,000,000. Because the fee is a flat dollar amount, a higher account balance would have the result of increasing reflected performance, while a lower account balance would have the result of decreasing reflected performance.

[3] These accounts were funded with more than the minimum amount required to establish an account. There is no fee schedule; all accounts are charged the same asset-based fee. Therefore, performance is not affected by the account's asset level.

[4] This account was funded with the minimum amount required to establish an account at the time of opening. Had the account been funded with more assets it would, at certain asset levels, be eligible for a lower advisory fee. The lower advisory fee would have the result of increasing reflected performance.

[5] This account was funded with more than the minimum in order to take advantage of tax-loss harvesting. Tax-loss harvesting may result in better or worse performance compared to similarly positioned accounts that are not enrolled in tax-loss harvesting. This account is enrolled in their digital only "Intelligent Portfolios", thus it is not charged an advisory fee. If one were to upgrade to "Intelligent Advisory" which introduces access to live advisors, an asset-based advisory fee would be levied, which would decrease reflected performance.

[6] These accounts were funded with the minimum amount required to establish an account. At balances less than $10,000, there is no advisory fee. Had the account been funded with $10,000 or more, an asset-based advisory fee would be levied, which would decrease reflected performance.

[7] These accounts were funded with the minimum amount required to establish an account at the time of opening. There is no fee schedule; all accounts are charged the same asset-based fee. Therefore, performance is not affected by the account's asset level.

[8] These accounts have no minimum required to establish an account. There is no advisory fee on these accounts. Had additional service packages, such as tax-loss harvesting, been added, the lesser of an asset-based fee or flat dollar fee would have been assessed. These fees would decrease the reflected performance.

[10] These accounts were funded with the minimum amount required to establish an account. This account is enrolled in their digital only "Essential Portfolios" and is charged an asset-based advisory fee. If one were to upgrade to "Selective Portfolios" which introduces access to live advisors, a higher asset-based advisory fee schedule would apply, which would decrease reflected performance.

[15] This account has no minimum required to establish an account and is enrolled in the Digital Only plan. If the account was enrolled in the premium service with access to live advisors, there would be a higher asset-based advisory fee. The higher advisory fee would have the result of decreasing reflected performance.

[21] These accounts were funded with more than the minimum amount required to establish an account. There is no fee schedule; all accounts are charged the same asset-based fee. Therefore, performance is not affected by the account's asset level. Fee was waived for the first year. Had a fee been levied, reflected performance would have been lower.

[22] These accounts were funded with more than the minimum amount required to establish an account. There is currently no fee schedule; all accounts are charged the same asset-based fee. Therefore, performance is not affected by the account's asset level. Previously, the fee was only assessed on balances in excess of $10,000.

[A] On June 19th, 2017, Vanguard removed Backend Benchmarking's primary Vanguard account from the Vanguard Personal Advisor Services program. As of June 20th, 2017, the primary account was replaced by a secondary account with the same risk profile as the primary account. The returns for the secondary account have been linked to the original primary account. Asset type and allocation between the two accounts at the time of the switch were very close but not identical.

[B] In the 1st Quarter of 2018 Wealthfront liquidated the positions in the account used for the 4th Quarter 2017 and previous editions of this report. A different account was used for this report and is labeled "Wealthfront (Risk 4.0)". The performance numbers from the previous account are available in the addendum labeled as "Wealthfront (Risk 3.0)". The risk scores and thus allocations of the two accounts are different and labeled as such. Asset type and allocation between the two accounts at the time of the switch were close but not identical. The difference of equity allocation between the accounts on 12/31/2017 was approximately 5.4%.

In previous reports the initial target asset allocation was calculated as the asset allocation at the end of the first month after the account was opened. In the Q3 2018 report we adjusted our method to calculate the initial target asset allocation as of the end of the trading day after all initial trades were placed in the accounts. This adjustment has caused some portfolio's initial target allocation to be updated from previous reports. These updates did not change any initial target allocations of equity, fixed income, cash, or other by more than 1%.

Prior to Q3 2018, due technological limitations of our portfolio management system, some accounts which contained fractional shares had misstated the quantity of shares when transactions quantities were smaller than 1/1000th of a share in a position as a result of purchases, sales, or dividend reinvestments. This had a marginal effect on historical performance of the accounts. The rounding of position quantities caused by this limitation has been resolved, and quantities have been adjusted to reflect the full position to the 1/1,000,000th of a share as of the end of Q3 2018. Therefore, this rounding of fractional shares will not be necessary in the future.

This report represents Backend Benchmarking's research, analysis and opinion only; the period tested was short in duration and may not provide a meaningful analysis; and, there can be no assurance that the performance trend demonstrated by Robos vs indices during the short period will continue. Backend Benchmarking is under common ownership and control with Condor Capital Management, an SEC registered investment adviser. A copy of Condor's disclosure Brochure is available at www.condorcapital.com. Condor Capital initiated a position in Schwab and TD Ameritrade in one of the strategies used in many of their discretionary accounts on 5/30/2017 and 5/31/2017. As of 12/31/2018 the total size of the position was 35,696 shares of Schwab common stock and 33,254 shares of TD Ameritrade common stock.

For more information, please contact BackendBenchmarking at Info@BackendB.com

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