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## *The Computer Made Me Do It!*

From automated airplane piloting systems to fuzzy logic home appliances to navigation “apps” on smart phones, algorithms are part and parcel of daily life. Even so, they are often unseen, unnoticed and hardly thought about by the average person.

On Amazon, algorithms set and update prices as well as predict what you are most likely to buy. Google’s algorithms filter search results based on your past searches and what they determine probably interests you most. Facebook also filters postings and newsfeeds based on what it specifies you are most likely to like. And when the “internet of things” is fully developed, it will consist of all sorts of smart devices, such as refrigerators, home security systems and phones, ascertaining our circumstances and communicating our statuses.

Basically, an algorithm is no more than a formula of step-by-step instructions for a computer program to follow. It tells the program not only what to do but how to do it. However, as Luke Dormehl, author of *The Formula: How Algorithms Solve All Our Problems and Create More* (Penguin Group, 2014), noted, “. . . if their description is straightforward, their inner workings and impact on our lives are anything but.”

Wall Street has long been enamored with algorithms. Even though there are numerous examples of financial formulas running amuck -- such as the trading firm Knight Capital going bankrupt in 2012, the Flash Crash in 2010 and the hedge fund Long Term Capital Management collapsing in 1998 -- Wall Street keeps finding new ways to use them. Hedge funds and institutional investors have used algorithms for trading for years, but now there are firms offering algorithm-based programs for investing targeted to individual investors.

These online, automated firms have been dubbed “robo-advisors.” Some even offer research produced by computer programs -- “robo-research,” if you will. We thought this is an excellent time to review algorithms and investing.

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First, let's look at a real world example of an algorithm. Suppose a friend is arriving at the airport. Algorithms solve problems and the problem here would be how to get your friend to your home. Let's say there are four options: hailing a taxi, renting a car, taking a bus or calling you to come pick him up. Each of these options is essentially an algorithm that accomplishes the same goal -- your friend arriving at your home.

There are different steps for each option. For example, in the "hail a taxi" algorithm your friend must first go to the taxi stand, get in a taxi, and then give the driver your address. In addition to different steps, each option also has different costs and travel times. Taking the taxi is likely the most expensive option but also the fastest. Taking the bus would be less expensive but also a lot slower than the other options. Which option your friend chooses will be based on the trade-offs for him between cost and travel time.

Similarly, in computer programming, there are different ways of accomplishing a goal and an algorithm can have both advantages and disadvantages depending on the task. Importantly, as the problem being solved becomes more complex so does the algorithm.

This is where the issue of "black boxing" comes in. In many cases, algorithms are constructed so that users have no idea how they work. Technologists tend to view simple user interfaces on top of complex programming as necessary and practical. Marissa Mayer, now President of Yahoo! and formerly a long-term executive of Google, once stated:

*"We think that that's the best way to do things. Our users don't need to understand how complicated the technology and the development work that happens behind this is. What they do need to understand is that they can just go to a box, type what they want, and get answers."*

However, when there is little or no understanding of how a computer program works, there is a tendency to see it as infallible and authoritative, or as one observer noted "the embodiment of objectivity." And an opaque black box combined with perceived objectivity means that the user is basically being encouraged to accept the answer as given. No additional information is needed. Furthermore, the filtering effect, as seen in Google searches or Facebook postings, means that some data is simply not presented at all. As a result, the data being hidden could actually be lost opportunities.

Complex algorithms are an issue not only for users but also for the programmers creating them. A few years ago, Netflix held a competition for the best algorithm to predict user ratings of films for its DVD and streaming video services. The prize was \$1,000,000 and it was won by a team that created an algorithm that beat Netflix's own predictive formula by just 10%. Netflix never implemented it, though, as the costs were determined to far outweigh any benefits. One expert who followed the competition observed:

*“It’s not just you and I who don’t understand how these algorithms work -- the engineers themselves don’t understand them entirely. If you look at the Netflix Prize, one of the things the people responsible for the winning entries said over and over again was that their algorithms worked, even though they couldn’t tell you why they worked. They might understand how they work from the point of view of mathematical principles, but that math is so complex that it is impossible for a human being to truly follow. That troubles me to some extent. The idea that we don’t know the world that we’re creating makes it very difficult for us to operate ethically and mindfully within it.”*

Thus, there are a number of valid reasons to be careful about the answers provided by algorithms. Formulas certainly have their uses but investors would be well-advised to be at least familiar with the issues surrounding their application, particularly in investing.

Although robo-advisors constitute only a sliver of the \$18 trillion wealth-management industry, about \$16 billion, over the last five years or so they have become increasingly popular. More than 200 such companies now exist, ranging from small venture-capital funded start-ups to mutual fund and brokerage giants Fidelity, Vanguard and Charles Schwab. Fees for robo-services typically range from 25 basis points of assets under management (0.25%) up to 95 basis points (0.95%).

The services are online, automated programs that make recommendations based on a questionnaire that the client completes. Some of the questions have to do with age and annual income while others ask multiple choice questions to determine investment goals and tolerances for risk, as well as the personality and temperament of the client.

The recommendations made by the algorithms tend to focus on low-cost, passively managed exchange traded funds (“ETFs”) covering different asset classes. Fees for these funds usually are charged separately by the ETF. The asset classes can include U.S. as well as international equities, fixed-income, real estate or other alternative investment classes.

One important factor to consider is the passive nature of most ETFs, which are usually benchmarked to a specific index. The passive investing approach is based on holding exactly the same securities in the same proportions as the benchmark index. Some popular indices are the Standard & Poor’s 500 and the Dow Jones Industrial Average but indices also exist for other asset classes and even specific market segments.

The key point is that the portfolio managers of a passively managed ETF do not make decisions about which securities to buy or sell. They just follow the same methodology as the index to which they are benchmarked and construct the same portfolio. When companies are added or deleted from the index, the ETF managers follow suit. No judgment call is being made as to whether or not the securities merit investment in the first place.

Last April, *The Wall Street Journal* compared five different robo-advisors. Each firm was asked to make recommendations for the same hypothetical moderate-risk investor. The five robo-advisor firms were Wealthfront, Betterment, TradeKing Core, Motif Horizon and Schwab Intelligent Portfolios.

Wealthfront and Betterment were both founded about five years ago and are the larger and more established robo-advisors. TradeKing Core and Motif Horizon are discount brokerage houses offering low-cost robo-services. Charles Schwab's Intelligent Portfolios services were introduced just a few months ago.

The *Journal* reported that the recommendations varied considerably. The allocation for U.S. stocks ranged from a low of 30% to a high of 41% while the portion allotted to international stocks ranged from 13% to 36%. In terms of fixed-income securities, the recommendations ranged from 12% to 34% for U.S. bonds and from 0% to 29% for international bonds. There were also subtle differences in how the algorithms used small stocks, emerging markets and other asset classes.

Of course, the reason for the differences is that the computer programs reflect the opinions, biases and beliefs of the firms as well as the programmers writing the algorithms. The online client, however, has no way of determining what these biases are and is not likely to be even aware that such biases could exist.

Furthermore, if a client has a unique situation, robo-advisors are not capable of devising an appropriate investment strategy. A client either does or does not fit into the algorithmic box. And the computer programs are not able to take into account other holdings the client may own or other special circumstances.

Most importantly, the algorithms cannot discuss and offer reassurance when the stock markets experience a "flash crash," a bear market or other major event. In fact, given their short history, it is unknown what they would recommend during adverse markets. Finally, the algorithms allocate ETFs, they do not make judgments about what is going on with the companies inside the ETF. Robo-research is similar -- it is usually just a recital of facts with no insight or analysis.

At the Sundance Film Festival earlier this year, during a panel discussion called "How I Learned to Stop Worrying and Trust the Algorithm," Netflix's Chief Content Officer, Ted Sarandos, was questioned about the company's algorithms and its programming decisions. Many of its top hits were created by a small, select group of writers. Sarandos replied:

*"It is important to know which data to ignore. In practice, it's probably a seventy-thirty mix. Seventy is the data and thirty is judgment. But the thirty needs to be on top, if that makes sense."*

Indeed, it does make sense. In investing, we think the proper percentage is 100% judgment with the investment counselors at the top.