FIN 5350 - Computational Financial Modeling
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# "What Should Computational Financial Economists Do?"

Nowadays, one can find different opinions on what should computational financial economists do since this is a time dependent concept. In order to understand the meaning of this complex composition of terms, the first step is to revise the definition of each of its components. Computational is the word that sticks out the most when added to the already known interaction between finance and economics, which is the branch of economics that analyzes the use and distribution of resources in markets where decisions are made under uncertainty. Computational refers to the ability to calculate numbers or amounts involving the use of computers. Financial relates to money matters, transactions, the study of money, and investments of governments, institutions, businesses, groups, or individuals. On the same note, Economics is the science that deals with the allocation of scarce resources among an endless human need. It also studies human action and the thinking process behind it.

Now that these three fields have been explained, one can start grouping them together and thinking about the different uses they can have. Computational Financial Economics should analyze the behavior of the decision makers, individuals, that interact in the different financial markets and ease their calculations by using computers in order to reduce errors and time invested.

The history of Computational Finance can be traced back to the early 1950s thanks to Harry Markowitz. He designed a series of algorithms adjusted to the limited capacity of computers in that time to solve a portfolio selection problem. In 1960s, different portfolio managers got involved in arbitrage trading by using computers, this let them find arbitrage opportunities faster than their peers and keep exploring how processors could help with quantitative valuations and data processing. A decade later, in the 70s, the interaction between finance and computing relied on option pricing and mortgages. The 1980s marked a revolution in Wall Street for the different uses and applications developed by computational finance. New techniques aroused as replacement of traditional economic analysis that were often (still are) used in Finance.

As the Cold War ended, the range of this field extended to include more financial engineers using more powerful computers. The first academic degree in Computational Finance was offered in 1994 by a private US university. The growth of Computational Finance and Economics has extended to businesses and academic institutions that use software to apply these principles in a more user friendly way.

With the proper tools, there are many issues that Computational Financial Economists are able to solve. However, with so many options, is there really a unique set of topics that their knowledge and attention should be restricted to? If so, which ones?

Against all theory behind this field, Hayek would happily oppose to any phenomenon that it would try to model. A modern Hayek would disagree with the idea of trying to model everything and use supercomputers to get raw numbers that could leave behind important information. He would question the assumptions made for the models and try to convince the audience that not everything can be explained by them. However, in Finance we can see tangible

results that come from good investments decisions and arbitrage opportunities, thanks to the merger of these principles. So the same modern Hayek, could sympathize a little more with this practice.

Buchanan's (1964) argues that there is a necessity for the making of allocative decisions depending on their ending use or value. Even though computational financial economics intrinsically studies the individual, it also studies its different extensions along several association groups that end up being defined as the world. He quotes Milton Friedman to state: “Economics is the study of how a particular society solves its economic problem”. This top class of economists should develop algorithms, creating tools that will give the individual a better experience when confronted with the decision of what should that person invest in. It should direct the economist to think about processes and efficiencies, by not realizing that it has to choose between different outcomes, but also include a longing for maximization. Computers ease the process of constructing and determining quantitative models, that will lean towards the optimum point assigning less weight to the other choices, and easing the decision making process, if desired to be viewed objectively. The effects of introducing or eliminating an individual into the process, changes the game. That’s why it’s important to analyze the markets with different tools and examine how does it behave in different conditions. As a financial economist, look at external factors that might affect the model and take the role of being an agent and modify it.

A very interesting branch of this field is Agent Based Computational Economics, which tests theory against real-world data to try to support cumulative time dependent theories, building on the appropriate previous work to see different possible outcomes.

This field has rerouted and focused more on mathematical consistency, which is extremely important, but forgotten about the compatibility with economic theory. Money should be the main focus, as well as the 'independent' variables that affect its value such as interest rates, time, value of shares, availability of certain resources, and perceptions. Recognizing individuals as the ones that provoke all adverse effects with their decisions, it's important to observe how investors would apply decision theory to its investments and try to model their behavior. It should focus on evaluating the relationship between those who own capital and those who need and the maximization of a company's present value, regardless of the preference of its shareholders. On the other hand, there's an available and important role at a government level when determining the economic direction, a country should take.

Another hard concept to grasp is integrating the human factor and always remembering that financial decisions are made by rational decision makers, who are really economic agents of limited rationality. In a dynamic world, they should find what area of focus would be most beneficial to them and where they realize they could make a difference or provide insight. As they have been doing, they should keep contributing to society by evaluating the fair price and value of stocks and other items within the economy. This is important because they will be able to influence the economies of specific countries and the world economy also.

Even though there have been many applications listed throughout the paper, here's a list of more specific ideas to work on:

1. Data analysis for the government or other agencies
2. Data analysis and business intelligence for corporations
    a. Present large data sets where structures/patterns can be identified to solve a crisis
3. Influence economic policy within the government and the world through findings

    a. AKA resolving agricultural problems
    b. Determining the effects of global warming on the country and world economy
    c. Determining how certain climates and times of year influence a demographic/country/state economy
4. Assist in the resolution of economic crisis that may arise or are currently a problem (AKA Social security, Obamacare, trade agreements between countries, etc.)

The beauty of Computational Financial Economics is that should and can be applied to anything that relates to the interaction between humans their financial markets. It can pick up social aspects that evaluate how does the individual react depending on different economic shocks and the financial consequences that its actions might cause. In addition, it is able to reveal the individual's decision making process in isolation and in a group, and flexible enough to convey these decisions into already implemented exchanges in the form of financial products. Now, despite the fact that there's a broad spectrum of things that Computational Financial Economists should do, "Is it possible, in the final analysis, for one human being to achieve perfect understanding of another?" (Haruki Murakami).

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