

Computational Finance Using C And C

Computational finance

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Computational finance is a branch of applied computer science that deals with problems of practical interest in finance. Some slightly different definitions are the study of data and algorithms currently used in finance and the mathematics of computer programs that realize financial models or systems.

Computational finance emphasizes practical numerical methods rather than mathematical proofs and focuses on techniques that apply directly to economic analyses. It is an interdisciplinary field between mathematical finance and numerical methods. Two major areas are efficient and accurate computation of fair values of financial securities and the modeling of stochastic time series.

Computational science

Computational science, also known as scientific computing, technical computing or scientific computation (SC), is a division of science, and more specifically

Computational science, also known as scientific computing, technical computing or scientific computation (SC), is a division of science, and more specifically the Computer Sciences, which uses advanced computing capabilities to understand and solve complex physical problems. While this typically extends into computational specializations, this field of study includes:

Algorithms (numerical and non-numerical): mathematical models, computational models, and computer simulations developed to solve sciences (e.g, physical, biological, and social), engineering, and humanities problems

Computer hardware that develops and optimizes the advanced system hardware, firmware, networking, and data management components needed to solve computationally demanding problems

The computing infrastructure that supports both the science and engineering problem solving and the developmental computer and information science

In practical use, it is typically the application of computer simulation and other forms of computation from numerical analysis and theoretical computer science to solve problems in various scientific disciplines. The field is different from theory and laboratory experiments, which are the traditional forms of science and engineering. The scientific computing approach is to gain understanding through the analysis of mathematical models implemented on computers. Scientists and engineers develop computer programs and application software that model systems being studied and run these programs with various sets of input parameters. The essence of computational science is the application of numerical algorithms and computational mathematics. In some cases, these models require massive amounts of calculations (usually floating-point) and are often executed on supercomputers or distributed computing platforms.

Computational engineering

Computational engineering is an emerging discipline that deals with the development and application of computational models for engineering, known as computational

Computational engineering is an emerging discipline that deals with the development and application of computational models for engineering, known as computational engineering models or CEM. Computational engineering uses computers to solve engineering design problems important to a variety of industries. At this time, various different approaches are summarized under the term computational engineering, including using computational geometry and virtual design for engineering tasks, often coupled with a simulation-driven approach. In computational engineering, algorithms solve mathematical and logical models that describe engineering challenges, sometimes coupled with some aspect of AI.

In computational engineering the engineer encodes their knowledge in a computer program. The result is an algorithm, the computational engineering model, that can produce many different variants of engineering designs, based on varied input requirements. The results can then be analyzed through additional mathematical models to create algorithmic feedback loops.

Simulations of physical behaviors relevant to the field, often coupled with high-performance computing, to solve complex physical problems arising in engineering analysis and design (as well as natural phenomena (computational science)). It is therefore related to Computational Science and Engineering, which has been described as the "third mode of discovery" (next to theory and experimentation).

In computational engineering, computer simulation provides the capability to create feedback that would be inaccessible to traditional experimentation or where carrying out traditional empirical inquiries is prohibitively expensive.

Computational engineering should neither be confused with pure computer science, nor with computer engineering, although a wide domain in the former is used in computational engineering (e.g., certain algorithms, data structures, parallel programming, high performance computing) and some problems in the latter can be modeled and solved with computational engineering methods (as an application area).

Computational mathematics

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A large part of computational mathematics consists roughly of using mathematics for allowing and improving computer computation in areas of science and engineering where mathematics are useful. This involves in particular algorithm design, computational complexity, numerical methods and computer algebra.

Computational mathematics refers also to the use of computers for mathematics itself. This includes mathematical experimentation for establishing conjectures (particularly in number theory), the use of computers for proving theorems (for example the four color theorem), and the design and use of proof assistants.

Computational thinking

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Computational thinking (CT) refers to the thought processes involved in formulating problems so their solutions can be represented as computational steps and algorithms. In education, CT is a set of problem-solving methods that involve expressing problems and their solutions in ways that a computer could also execute. It involves automation of processes, but also using computing to explore, analyze, and understand processes (natural and artificial).

Quantum finance

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Quantitative analysis (finance)

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Quantitative analysis is the use of mathematical and statistical methods in finance and investment management. Those working in the field are quantitative analysts (quants). Quants tend to specialize in specific areas which may include derivative structuring or pricing, risk management, investment management and other related finance occupations. The occupation is similar to those in industrial mathematics in other industries. The process usually consists of searching vast databases for patterns, such as correlations among liquid assets or price-movement patterns (trend following or reversion).

Although the original quantitative analysts were "sell side quants" from market maker firms, concerned with derivatives pricing and risk management, the meaning of the term has expanded over time to include those individuals involved in almost any application of mathematical finance, including the buy side. Applied quantitative analysis is commonly associated with quantitative investment management which includes a variety of methods such as statistical arbitrage, algorithmic trading and electronic trading.

Some of the larger investment managers using quantitative analysis include Renaissance Technologies, D. E. Shaw & Co., and AQR Capital Management.

Computational economics

that rely heavily on computation. In the 21st century, the development of computational algorithms created new means for computational methods to interact

Computational or algorithmic economics is an interdisciplinary field combining computer science and economics to efficiently solve computationally-expensive problems in economics. Some of these areas are unique, while others established areas of economics by allowing robust data analytics and solutions of problems that would be arduous to research without computers and associated numerical methods.

Major advances in computational economics include search and matching theory, the theory of linear programming, algorithmic mechanism design, and fair division algorithms.

Agent-based computational economics

Agent-based computational economics (ACE) is the area of computational economics that studies economic processes, including whole economies, as dynamic

Agent-based computational economics (ACE) is the area of computational economics that studies economic processes, including whole economies, as dynamic systems of interacting agents. As such, it falls in the paradigm of complex adaptive systems. In corresponding agent-based models, the "agents" are "computational objects modeled as interacting according to rules" over space and time, not real people. The rules are formulated to model behavior and social interactions based on incentives and information. Such rules could also be the result of optimization, realized through use of AI methods (such as Q-learning and other reinforcement learning techniques).

As part of non-equilibrium economics, the theoretical assumption of mathematical optimization by agents in equilibrium is replaced by the less restrictive postulate of agents with bounded rationality adapting to market forces. ACE models apply numerical methods of analysis to computer-based simulations of complex dynamic problems for which more conventional methods, such as theorem formulation, may not find ready use. Starting from initial conditions specified by the modeler, the computational economy evolves over time as its constituent agents repeatedly interact with each other, including learning from interactions. In these respects, ACE has been characterized as a bottom-up culture-dish approach to the study of economic systems.

ACE has a similarity to, and overlap with, game theory as an agent-based method for modeling social interactions. But practitioners have also noted differences from standard methods, for example in ACE events modeled being driven solely by initial conditions, whether or not equilibria exist or are computationally tractable, and in the modeling facilitation of agent autonomy and learning.

The method has benefited from continuing improvements in modeling techniques of computer science and increased computer capabilities. The ultimate scientific objective of the method is to "test theoretical findings against real-world data in ways that permit empirically supported theories to cumulate over time, with each researcher's work building appropriately on the work that has gone before." The subject has been applied to research areas like asset pricing, energy systems, competition and collaboration, transaction costs, market structure and industrial organization and dynamics, welfare economics, and mechanism design, information and uncertainty, macroeconomics, and Marxist economics.

Recent integrations of reinforcement learning and deep learning architectures have enabled simulation of AI-driven agents in complex multi-agent economic models, enhancing realism and emergent behaviour forecasting.

Financial modeling

Models and Volatility Using Excel-VBA. New Jersey: Wiley. ISBN 978-0471794646. Antoine Savine and Jesper Andreasen (2018). Modern Computational Finance: Scripting

Financial modeling is the task of building an abstract representation (a model) of a real world financial situation. This is a mathematical model designed to represent (a simplified version of) the performance of a financial asset or portfolio of a business, project, or any other investment.

Typically, then, financial modeling is understood to mean an exercise in either asset pricing or corporate finance, of a quantitative nature. It is about translating a set of hypotheses about the behavior of markets or agents into numerical predictions. At the same time, "financial modeling" is a general term that means different things to different users; the reference usually relates either to accounting and corporate finance applications or to quantitative finance applications.

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