

Financial Mathematics Using Web Technologies

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Abstract

Financial mathematics is a branch of applied mathematics that forms methods to financial markets and management. Financial math is used to predict the behavior of the markets and market trends and suggest strategies for investments. Web-based applications are the leading technologies. The focus of this article is on mathematical theories of finance using web technologies in another words combination of financial mathematics and web technologies.

Keywords: Financial Mathematics, Web Technologies, Mathematical Models for Finance.

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Introduction

Financial mathematics is a branch of applied mathematics and equivalently it can be called as financial engineering, mathematical finance, and computational finance. Financial mathematics cannot be thought without computer science since more sophisticated mathematical tools and theories have been used in financial mathematics by researchers. Researchers are trying to find solutions for the problems in finance such as valuation, risk management, portfolio structuring, and modeling to simulate scenario. They are trying to improve models to figure out the market trends and behavior of the market, issues that have impacts on pricing and valuation of financial assets. The fundamental relationships between variables such as asset prices, markets trends and interest rates by using models those include mathematical tools such as probability, statistics, computing, and partial differential equations. Researchers are creating more realistic models however at the same time these models are getting more sophisticated. Saving due to models, error margins of models or accuracy of models, efficiency of models for the financial institutions are becoming more difficult issues that must be answered after establishing models for the market.

Web technologies are the leading technology and have impacts on many field of life and it has impacts on finance too. E-commerce is the primary web technology in finance. Real-time data feed, large-scale data base and online trading are all possible by using web technologies. For observation of market trends and variables in the market, obtaining real-time data and large-scale data are very important. Web technologies can be integrated into financial mathematics so observing and evaluating of models become more practical.

Extended Description

Stock markets date is back to at least 16th century and mathematical modeling of financial markets by using probability started in 1900. The theory of portfolio optimization by Harry Markowitz is the first influential work of mathematical finance. Harry Markowitz tried to understand and quantify the risk and return of an entire portfolio of stocks and bonds by using an optimization strategy to choose a portfolio with largest mean return subject to acceptable levels of variance in return. William Sharpe studied on determining the correlation between each stock and the market in the same time period of Harry Markowitz's work. The next vital contribution in mathematical finance is the work of Fisher Black and Myron Scholes along with fundamental contributions by Robert C. Merton by modeling financial markets with stochastic models. In the last few years financial mathematics has been using sophisticated concepts such as martingales and stochastic integration. Many economists think that these models are having an enormous impact on the way modern financial markets operate. However some economists claim that all experts in the market are all aware of the limitations of Black-Scholes model. Modeling of new derivative securities for the development of pricing is becoming very difficult in the field of financial mathematics.

Web technologies are the leading technologies and have impact on finance like having impacts on many other areas. E-commerce is a primary web technology in finance. Customers' profiles and banks strategies have been changed due to web technologies. The customers in many different areas in the market are becoming online.

The web technology has the ability to communicate with billions of people across millions of computers across hundreds of countries. Web technology provides us infor-

mation and it can be considered as a series of databases. Real-time data feed, online trading, automated trading, large-scale databases, tracking and monitoring of market conditions are all possible by using web technologies. Modern financial math cannot be thought without computers. Computers are used to model the behavior of financial securities, key indicators, pricing models. These topics are included in financial computation. However using web technologies for financial math is a new concept. This article is for giving ideas to integrate web technologies into financial mathematics to understand market trends by using models. How web technologies can be used for financial mathematics? Topics of financial mathematics are getting wider and more sophisticated. So application of web technologies to all topics of financial mathematics can be regarded as not practical but one of the main purposes of financial mathematics is finding models for behaviors of the market and market trends. The number of web-enabled workstations within companies reaches huge values, it makes possible for companies to learn and adopt new ways of managing in the market. Internet allows organizations to manage and maintain their own capital. Information is the basis key for production, marketing, and strategic decisions. The ability to analyze, manipulate and view is related to rapid information that comes from the market. The profitability becomes more dependent on real-time information and modeling for optimization is playing an increasingly important role in financial decisions. The internet excels in bringing together instantaneous information and millions of people around the world. The rate of growth of online investing has been increasing each year.

Stochastic models are used in the modeling of financial markets, relations between different economic factors are tried to capture by using these models. These methods can model the evolution in time of various economic quantities. Stochastic calculus is very important in the theory of modeling of financial markets. Many sophisticated mathematical techniques have been developed for analyzing financial markets and their trends. Many mathematical models have been used for these purposes. Researches in finance and economics try to understand behavior of the markets by being modeled prices, investors, companies, customers' trends...etc. These models should be realistic and easy to perform to implement for the market. However in generally, easier models to implement are less realistic and more realistic models are more difficult to implement. There are many factors and unpredictable events which influence prices of goods in the market and market trends.

The main idea of this article is to combine web technologies and financial mathematics to create models the markets and their trends. Web technologies can give idea how a model is realistic and how it is easy to perform computations and get solutions in the market. A chosen market is to be monitored through internet and a model using

financial mathematics techniques is implemented to this market, and outputs can easily be obtained and these outputs can be observed for realistic models. More realistic models are developed for the trends of market by observing market using web technologies.

Financial Markets, Financial Assets, and Market Participants

Financial asset is defined by Wikipedia.org as follow:

Anything tangible or intangible that is capable of being owned or controlled to produce value and that is held to have positive economic value is considered an asset. Simply stated, assets represent ownership of value that can be converted into cash (although cash itself is also considered an asset)

Financial market is a mechanism that financial assets, commodities or any securities are traded.

Market participants are the players in the market who buy and sell financial assets.

Financial Mathematics

Financial mathematics concerns with the financial markets, its trends and behaviors. It has close relationship with financial engineering, computational finance and financial economics. Financial mathematics' articles can be divided into two main parts, mathematical tools and derivatives pricing.

Modeling for Finance

Models in finance are used to predict marker trends, to manage investments and risks, and to predetermine cash flows in the market.

Integrating Web Technologies into Financial Mathematics

Financial mathematics using web technologies is a new concept. The idea in this thesis article is based on observing market trends by using web technologies and shaping the models that is created to figure out market trends and variables in the market that have impacts on financial assets, commodities, and securities.

Web Technologies

Designing, coding, building, testing, documenting, implementing, and supporting web pages and web sites, web-based applications are main topics of web technologies. Web and Internet are sometimes regarded as same issues. Services of web technologies run on the Internet,

these services are collection of interconnected documents, applications, and other resources.

Areas and applications of web technologies are getting wider and wider. New concepts have been introduced related with web technologies in recent years. However the application of web technologies for mathematical finance is quite new.

Contributions

Financial mathematics uses mathematical modeling, statistics & probability, and operational research to maximize profit for an investment or to evaluate a financial product. It has many applications and these applications become extremely important for the world’s financial institutions. It can make a difference and it can influence decision-making in the financial markets. Financial mathematics is flourishing in the modern science. Real-time data feed, online trading, and large-scale data base are becoming vital for creating models to understand behavior of the markets’ trends. From this view, web technologies can be integrated into financial mathematics especially to create models for the market’s trends. There are many sophisticated financial models such as ROI (Return on Investment), IRR (Internal Rate of Return) and NPV (Net Present Value) used by banks however the margin of error is still high for

decisions that include multi-million dollars investments. Benefits and savings due to a created model by financial mathematician are not easy to measure and accuracy of model is another important issue that must be measured for the applied market. Data must be collected very carefully and examined for the errors of models. Web technology can supply researches a “living model” that real-time data feed is supplied by using web technologies and these data become a very huge data, then a model can be created that adopts to new market conditions instead of creating a constant model by using web technologies a model can be created that has ability of changing and renewing like the market’s trends and behaviors. To be successful, the market must be monitored by using web technologies, all variables of the market must be screened for evaluating them, and the whole market can be monitored by connecting all sub-markets. Researches will have a great chance to observe market’s trends and accuracy of the created model for the market. Success of the models can be measured easily and impact of the models for decision making strategies can be seen easily.

As the mathematical models for finance are getting more sophisticated, the measuring effect and benefits of the model, and also the measuring the margin of error are getting more sophisticated. Large-scale data based and real-time data feed by using web technologies can increase accuracy of models.

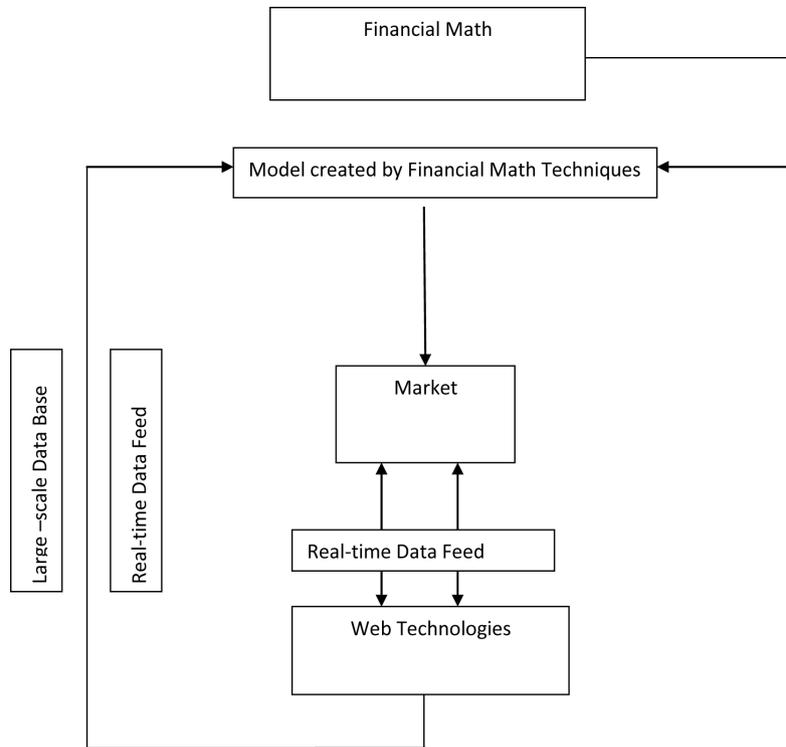


Figure 1: the relation between financial mathematics and web technologies

Conclusion

“More sophisticated mathematical models and derivative pricing strategies were then developed but their credibility was damaged by the financial crisis of 2007–2010. Bodies such as the Institute for New Economic Thinking are now attempting to establish more effective theories and methods.”(Gillian Tett (April 15 2010), Mathematicians must get out of their ivory towers, Financial Times). Financial mathematics that is integrated web technologies is a new concept that mathematicians or scientists can develop new models for financial areas. Some unreal assumptions such as equal chance of accessing information can be removed in the models by web technologies by real time data. This concept is quite new but inspirational for developing new models.

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