Last updated on February 27th, 2021 at 10:49 amThe terms financial mathematics and financial economics are often interchanged and thought of as the same discipline. Financial analysis is a different discipline all-together that uses elements from financial mathematics and financial economics in doing an in-depth analysis of the targeted firm regarding its financial sustainability. Let's compare and see how they differ. What is Financial Mathematics? Financial mathematics can be understood as the field that is concerned with mathematical applications in finance. Solving financial problems using mathematical methods is the main focus of financial mathematics. Financial mathematics is alternatively termed as quantitative finance and computational finance. The major applications of quantitative mathematics are in the field of securities valuation, risk management, and portfolio structuring, etc. by financial institutions like investment banks, hedge funds, and insurance companies. Financial mathematics also plays a crucial role in commodities-based industries. The valuation of various financial instruments requires mathematical modelling of financial markets. What is Financial Analysis? Financial analysis can be defined as the process of evaluating a business or a project using different techniques such as ratio analysis that helps to ascertain the suitability and viability of the business. Major applications of financial analysis are in evaluating economic trends, building financial policy, etc. The results obtained after a rigorous financial analysis help different stakeholders in decision making. Internally conducted financial analysis helps managers to make an informed decision or study successful historical trends. Financial analysis is further classified into two parts -fundamental analysis and technical analysis, let's delve into the details of both the techniques. Fundamental Analysis Fundamental analysis uses the approach of evaluating securities and conducting financial analysis by measuring the intrinsic value of the security. Fundamental analysis takes a more comprehensive view of the organisation and considers different factors such as economic conditions, industry outlook, management of the company, etc. It also evaluates the company on account of assets, liabilities, expenses, income generated, etc. Technical Analysis Technical analysis is different from the fundamental analysis technique for evaluating the viability of the company. It has only two inputs in the whole evaluation method. The two elements of this technique are stock prices and volume. It assumes that stock prices reflect other important fundamentals of the company. This method uses stock charts and other tools to predict the future trends of the stock. What is Financial Economics? Financial economics is a discipline in economics that is concerned with the analysis of the use and distribution of resources in the market. It studies how different factors such as opportunity cost, risk, time, etc. play a crucial role in creating incentives or disincentives for any specific decision. It involves employing complex financial models to test the variables influencing a particular decision. Rational consumer behaviour is an important and common assumption with these models. Microeconomics, econometrics and basic accounting concepts form the pillar of this discipline of economics. Financial economics requires a basic understanding of the concept of probability and statistics. Comparing the three Now that we have individually learned about all three disciplines the difference is very evident. Let's compare how they differ from each other, starting with the comparison between financial mathematics and financial analysis. Financial mathematics is a field of applied mathematics that is concerned with the financial markets whereas financial analysis is the assessment of different elements that paints a picture of the functioning of the business which will help different stakeholders in informed decision making. Financial economics is heavily concentrated on two aspects of finance, asset pricing and corporate finance. The role of a financial economist requires collecting and analysing statistical data using different sampling and econometric techniques. HandWiki Wiki Encyclopedia of Knowledge HandWiki is a wiki encyclopedia for collaborative editing of articles on computing, science, technology and general knowledge. Registered users can post and edit articles, books, manuals and tutorials. Login or request account using the top-right menu. Read more here. Featured Article Carl Jung Synchronicity is a concept first introduced by psychologist Carl G. Jung to describe circumstances that appear meaningfully related yet lack a causal connection. In contemporary research, synchronicity experiences refer to one's subjective experience that coincidences between events in one's mind and the outside world may be causally unrelated to each other yet have some other unknown connection... Read More Did You Know? Designed World is a YouTube channel dedicated to unexplained phenomena and unusual observations. Submit your favorite remarkable cases related to unexplained, and the channel will create a visual short story. Read more and subscribe You can publish encyclopedic articles and blogs using a decentralized publishing platform called EnHub (enhub.org). The articles can also be saved and downloaded using the ZWI file format. 6174 is the Kaprekar's constant, but it is often called "magic number". At first glance, the number 6174 looks like any other number, but .. Read more Can you hold 70,000 books in one hand?If you are reading this blog, you are a certifiable smart person and probably know about Project Gutenberg (PG)... Read more Advanced PCB Designs for Improved Fault Detection in Electrical Installations ... Read more Wiki of Our Sponsors DataMelt is a free software for numeric computation, mathematics, statistics, symbolic calculations, data analysis and data visualization. The program runs on Windows/Mac OS/Linux.. Read More.. Mathematics and Computer Science Here are articles on abstract concepts related to computing in a broad sense. Such topics unify foundations of mathematics with computations using computers, and can be applied to many branches of science, finance or technology. Mathematics is an essential tool in computing, but computers are used as a main tool in mathematical problem solving. These topics cover all branches of mathematics, statistics, computer science, data analysis, machine learning and information science. Natural and Formal Sciences" are dedicated to the study of natural phenomena and physical world. Humanities Here are the portals dedicated to the study of aspects of human society and culture. This group of topics includes arts, practices and procedures used to maintain state of physical, social and mental well-being. Technology, Tools and Finance Here are articles dedicated to various technology topics (building complex devices and machines), software (programs and operating systems) and finance (study of money and investments). Companies, Organizations and People Here are articles about organizations, companies and people contributing to research and technology. They serve to support the citations in HandWiki's research articles and books. Books, Monographs, Manuals and Tutorials Here are books, monographs and tutorials. Books and manuals are organized as collections of articles, and typically span many wiki pages. A monograph discusses a detailed study of a single specialized subject. Monographs use a single wiki page. Topical in-depth encyclopedias Here are in-depth encyclopedias organized according the scientific fields supported in HandWiki. Help This section contains the description of the HandWiki encyclopedia project. I am choosing between these two programs. Professors on qf program have more references, articles, better degrees than mathematical finance. Financial mathematics have harder program, but can still be compared with qf programme. Profs who teach math finance subjects at math finance dont really have any experiences and published articles. I am just afraid my math, probability etc. knowledge going by myself out of school will be worthless in eyes of employers. And all this profs are also highly qualified in quantitative finance. Which do you reccomend, how strictly do employers look at these things? I currently have more rust in qf program and if I study by myself advanced math and statstics/probability I am thinking I might get an edge on financial maths graduates. On one side, I can clearly see qf is obvious choice, but I am still afraid that this can close me some doors. Please, any advice would be greatly appreciated! On balance, QF. But saying this is next to useless. Look at the actual courses offered when you're making a comparison, regardless of whether a program is described as QF or FM. See also which department is offering it, and which profs will do the teaching. Basicly, qf has better professors and more up to date subjects. But it lacks subjects in pure mathematics, probability, statistics and programmingand has one course with probability and mathematics combined and one programming course). Profs who teach math finance subjects at math finance dont really have any experiences and published articles. I am just afraid my math, probability etc. knowledge going by myself out of school will be worthless in eyes of employers. All this profs are mostly not known level European profs. Deciding question is how much employers in qf trust in self acquired knowledge, how will I be able to compete with mathematicians if I will have same knowledge? In the late 1980s, when I began to get involved in the training of future professionals of the financial sector, mathematics did not play the role they were given afterwards. But with Helyette Geman (ESSEC), I had spent a whole year in a bank analyzing and explaining to practitioners the first stochastic interest rate models. At that moment, I experienced a genuine intellectual meeting. In fact, it soon emerged that there would be a growing need for professionals able of understanding maths: quantitative issues were becoming a central part of finance. Meanwhile, we also needed to train mathematicians able to understand finance: "quants" that have enough understanding of the scientific community. However, at that time, the main issue wasn't only about the use of high-level mathematics in the world of finance: it was also the beginning of a new conception of risk. "Noise" vs. the fundamentals? From the start, one of the aims of the world of finance consisted in managing and reducing risks as much as possible. During the late 1980s, a quantum leap was achieved thanks to the quick development of dynamic strategies, as opposed to techniques that had previously been applied by ensuring an average risk through the weighting of different asset classes. During the development of financial mathematics in the early 1990s, the first challenge was to implement a dynamic hedging, supported by increasingly sophisticated mathematical models. And as the models strengthened, researchers and practitioners started to examine more closely, not only the models themselves, but also the disruptive factors, the random elements that distorted curves. Indeed, markets can be represented as dynamic systems disturbed by "noise". It is precisely this noise (i.e. the day to day volatility) which received, in the mid-1990s, all the attention. Not without consequences, as we shall see. And it would be interesting to know what led traders, those who trained them, and those who conceived the software they use, to focus on this immediate aspect. During those years, from a technical point of view, the context was changing rapidly. With the development of the processing power of computers, simple models (binomial, with the possibility of additional parameters) that could be calculated by hand were replaced by more sophisticated calculations, involving specialized software. In 1990, in Chicago, they would use the same computer systems as in 1973! And other world stock markets were not much more advanced. This situation didn't last very long and progresses have been achieved. On one hand, we have a very quick revolution of the market size and on the other, an equally rapid implementation of sophisticated techniques to apprehend them. For instance, partial differential equations are very quickly calculated by computers. This paves the way for more complex probabilistic techniques, which allow more refined models. For example, techniques such as Monte-Carlo, which consists in repeating a lot of times a phenomenon in order to obtain a more reliable approximation of the true value of the mathematical expectation. The nature of financial expertise changed completely. From a scientific point of view, it was very exciting. The aim was to integrate increasingly complex equations, such as stochastic processes (random time-dependent phenomena), and compare the obtained models with the movements actually observed. Brownian "noise" becomes the object of attention, because it was not only a matter of anticipating but of measuring the immediate changes of the market. The noise was explained by the fact that the market participants react to immediate information, in other words, that noise creates noise. This phenomenon was exacerbated by the regulators' decision in 1998 to provide operators with daily information centered on the concept of value at risk. Fundamentally, it wasn't a bad idea: it provided richer and more complete information, and changes from one day to the other of the market price contain much useful information, for example on liquidity. But it went too far, in the sense that it led to underestimate the information based on the historical behavior of prices. Young traders we had trained had no experience or enough hindsight to free themselves from this focus on immediate data. They were mathematicians, not economists: they didn't care enough about the past nor the underlying. Both the models and the young people who used them were lacking the ability to articulate the risk of the underlying and that related to the market. Models become more sophisticated, but the same logic has persisted: we buy, we sell on a daily basis, and the statistical and historical information are neglected, and even disappear from models. But these are fundamental. This is a lesson for all players, but especially for those who, like me, are in charge of training: trainings focused on prices will have to rely more heavily on the historical aspect. Exactly, about fifteen years since the regulators are asking for it. And the recent crises have further increased the need to change the approach. Easier said than done! To take an example, the calculation of counterparty risk is more complicated on a yearly basis than on an instant basis. Today's challenges The world in which we live today does not know the same expansion as the years 1990-2000. Moreover, the crisis has highlighted the importance of the hidden, implicit links, and more generally of what we call the "systemic risk". To put things simply, until 2008 the focus was set on the "risk of noise". Since 2008, we are learning to manage the risk of chaos. In terms of risk management, this implies especially a stronger consideration of collateralization. In this context, financial mathematics are set to undergo an inflection. Earlier systems need to integrate different techniques: collateral management requires to follow several curves at the same time; taking into account the systemic risk poses considerable problems, since it requires both a better understanding and to prevent the creation of systems that by responding to signals from various areas systemically create more risk. Let's take as example, the credit derivatives that proliferated in the 2000s and that have played a crucial part in the 2008 crisis. Credit derivatives have grown significantly in recent years, and even before the crisis there were doubts about the robustness of the models on which they relied. As early as 1998, the U.S. regulator – who kept in memory the Black Monday of October 1987 – asked financial institutions to produce a daily Value at Risk of market risks, that is to say of the aggregate activity of a trading room. Although computers have gained significant power and that the models have been refined, it was – and remains – a real challenge for financial institutions and also for training facilities that provide the quants who will implement this new measure. Exchanges between the academic world and the market have intensified, especially around the relevance of VaR as a risk measure. In particular, we had discussed with professionals from trading desks, in the years preceding the crisis, of the risk of default. To summarize, the management of the risk of default was okay as long as the default was probable, but what would actually happen if default really occurred was never contemplated. The discussions were not successful (it's always difficult to discuss during a financial bubble!) and the issue is now back on the agenda. It is all the more urgent to address this problem that the concentration of the financial sector, further enhanced by the crisis, tends to make of each financial player, a systemic player. In this regard, it should be noted that until recently, mathematicians would validate models without knowing the size of the "poses" (exposures) which were behind. That's absurd! And tomorrow? All in all, a number of developments are underway or will be required, regarding both practices and training. Trainers are encouraged to put particular emphasis on statistics and to get students to work on a vision of global quantitative risk. This is now a central aspect. Some teachings have been reinforced: regulation, market risk. The range of the considered disciplines raises another problem. Indeed, a few months of training are barely enough for the student – even the most brilliant – to assimilate all of stochastic calculus, finance, statistics, law... The question of the time needed to ingest all this science is complicated because banks "hunt" our students already during their internships. Quants are very active in the areas of overall risk (risk analysis, simulations), but also increasingly in model validations. Ultimately, with the consciousness that when they build or validate a model, it will have an impact on prices. Taking into account the systemic dimension is a real challenge, but it offers a real opportunity for financial mathematics. Markets have worked for more than fifteen years on an imaginary real time: they need to build a different relation with time. Concerning this precise issue, quantitative finance has its word to say. The quantitative view of finance will not stop the pace, although in some sectors (asset management, finance) some dream of going back to the old-style, less sophisticated way of doing things. That will certainly not eliminate systemic risks! One more generally, rare risks don't exist: we can work at least on this basis, except to play with fire. Today, it is crucial to develop new tools (and train professionals) for risk detection, by reworking on the determination of the exposure to risk. The models are structurally imperfect. At best, they simplify the reality; but a model is wrong by definition. One important challenge is to clarify the use that can be made of them. Basically, the issue is to use them while knowing that they are false and, if possible, understand their limits. This is a critical issue for professionals, today: they must be able to understand the mechanics and identify the logic of what they use. And be able to worry if they don't understand the logic or spot aberrations. I believe that the issue of the position regarding the model is absolutely essential. A problem in this respect is that the regulator fixes a number of positions, instead letting them evolve. It's dangerous to think that defining a standard regulatory framework requires a consensus. This does not capture complexity, which requires a different approach. The more there is systemic risk, the more increased diversity is needed. Beyond the models, it is important to explore the areas where we can't explain everything. Another problem: during the crisis, much attention was paid to economists, when these are disconnected from the technological realities (high-frequency trading, new software...). The same goes for regulators and policy makers. There is therefore a danger of creating a regulation completely disconnected from market reality. I strongly believe in the necessity of a dialogue between the various players and the different disciplines involved. Share — copy and redistribute the material in any medium or format for any purpose, even commercially. Adapt — remix, transform, and build upon the material for any purpose, even commercially. The licensor cannot revoke these freedoms as long as you follow the license terms. Attribution — You must give appropriate credit , provide a link to the license, and indicate if changes were made . You may do so in any reasonable manner, but not in any way that suggests the licensor endorses you or your use. ShareAlike — If you remix, transform, or build upon the material, you must distribute your contributions under the same license as the original. No additional restrictions — You may not apply legal terms or technological measures that legally restrict others from doing anything the license permits. You do not have to comply with the license for elements of the material in the public domain or where your use is permitted by an applicable exception or limitation . No warranties are given. The license may not give you all of the permissions necessary for your intended use. For example, other rights such as publicity, privacy, or moral rights may limit how you use the material. {{Sidebar with collapsible lists | name = Finance sidebar | title = Finance | image = | listtitlestyle = background:#ddf;text-align:center; | listclass = plainlist | expanded = | list1name = markets | list1title = Markets | list1 = | list2name = instruments | list2title = Instruments | list2style = padding-left:2.0em;padding-right:2.0em; | list2 = Short description: Application of mathematical and statistical methods in finance Mathematical finance, also known as quantitative finance and financial mathematics, is a field of applied mathematics, concerned with mathematical modeling of financial markets. In general, there exist two separate branches of finance that require advanced quantitative techniques: derivatives pricing on the one hand, and risk and portfolio management on the other.[1] Mathematical finance overlaps heavily with the fields of computational finance and financial engineering. The latter focuses on applications and modeling, often with the help of stochastic asset models, while the former focuses, in addition to analysis, on building tools of implementation for the models. Also related is quantitative investing, which relies on statistical and numerical models (and lately machine learning) as opposed to traditional fundamental analysis when managing portfolios. French mathematician Louis Bachelier's doctoral thesis, defended in 1900, is considered the first scholarly work on mathematical finance. But mathematical finance emerged as a discipline in the 1970s, following the work of Fischer Black, Myron Scholes and Robert Merton on option pricing theory. Mathematical investing originated from the research of mathematician Edward Thorp who used statistical methods to first invent card counting in blackjack and then applied its principles to modern systematic investing.[2] The subject has a close relationship with the discipline of financial economics, which is concerned with much of the underlying theory that is involved in financial mathematics. While trained economists use complex economic models that are built on observed empirical relationships, in contrast, mathematical finance analysis will derive and extend the mathematical or numerical models without necessarily establishing a link to financial theory, taking observed market prices as input. See: Valuation of options; Financial modeling; Asset pricing. The fundamental theorem of arbitrage-free pricing is one of the key theorems in mathematical finance, while the Black–Scholes equation and formula are amongst the key results.[3] Today many universities offer degree and research programs in mathematical finance. History: Q versus P There are two separate branches of finance that require advanced quantitative techniques: derivatives pricing, and risk and portfolio management. One of the main differences is that they use different probabilities such as the risk-neutral probability (or arbitrage-pricing probability), denoted by "Q", and the actual (or actuarial) probability, denoted by "P". Derivatives pricing: the Q world The Q world Goal "extrapolate the present" Environment risk-neutral probability [math]\displaystyle{ \mathbb{Q} }[/math] Processes continuous-time martingales Dimension low Tools Itō calculus, PDEs Challenges calibration Business sell-side Main page: Finance:Risk-neutral measure The goal of derivatives pricing is to determine the fair price of a given security in terms of more liquid securities whose price is determined by the law of supply and demand. The meaning of "fair" depends, of course, on whether one considers buying or selling the security. Examples of securities being priced are plain vanilla and exotic options, convertible bonds, etc. Once a fair price has been determined, the sell-side trader can make a market on the security. Therefore, derivatives pricing is a complex "extrapolation" exercise to define the current market value of a security, which is then used by the sell-side community. Quantitative derivatives pricing was initiated by Louis Bachelier in The Theory of Speculation ("Théorie de la spéculation", published 1900), with the introduction of the most basic and most influential of processes, Brownian motion, and its applications to the pricing of options.[4][5] Brownian motion is derived using the Langevin equation and the discrete random walk.[6] Bachelier modeled the time series of changes in the logarithm of stock prices as a random walk in which the short-term changes had a finite variance. This causes longer-term changes to follow a Gaussian distribution.[7] The theory remained dormant until Fischer Black and Myron Scholes, along with fundamental contributions by Robert C. Merton, applied the second most influential process, the geometric Brownian motion, to option pricing. For this M. Scholes and R. Merton were awarded the 1997 Nobel Memorial Prize in Economic Sciences. Black was ineligible for the prize because he died in 1995.[8] The next important step was the fundamental theorem of asset pricing by Harrison and Pliska (1981), according to which the suitably normalized current price P0 of security is arbitrage-free, and thus truly fair only if there exists a stochastic process Pt with constant expected value which describes its future evolution:[9] [math]\displaystyle{ P_{0}=\mathbb{E}_{0} (P_{t}) }[/math] (1) A process satisfying (1) is called a "martingale". A martingale does not reward risk. Thus the probability of the normalized security price process is called "risk-neutral" and is typically denoted by the blackboard font letter "[math]\displaystyle{ \mathbb{Q} }[/math]". The relationship (1) must hold for all times t: therefore the processes used for derivatives pricing are naturally set in continuous time. The quants who operate in the Q world of derivatives pricing are specialists with deep knowledge of the specific products they model. Securities are priced individually, and thus the problems in the Q world are low-dimensional in nature. Calibration is one of the main challenges of the Q world: once a continuous-time parametric process has been calibrated to a set of traded securities through a relationship such as (1), a similar relationship is used to define the price of new derivatives. The main quantitative tools necessary to handle continuous-time Q-processes are Itō's stochastic calculus, simulation and partial differential equations (PDEs).[10] Risk and portfolio management: the P world The P world Goal "model the future" Environment real-world probability [math]\displaystyle{ \mathbb{P} }[/math] Processes discrete-time series Dimension large Tools multivariate statistics Challenges estimation Business buy-side Risk and portfolio management aims at modeling the statistically derived probability distribution of the market prices of all the securities at a given future investment horizon. This "real" probability distribution of the market prices is typically denoted by the blackboard font letter "[math]\displaystyle{ \mathbb{P} }[/math]", as opposed to the "risk-neutral" probability "[math]\displaystyle{ \mathbb{Q} }[/math]" used in derivatives pricing. Based on the P distribution, the buy-side community takes decisions on which securities to purchase in order to improve the prospective profit-and-loss profile of their positions considered as a portfolio. Increasingly, elements of this process are automated; see Outline of finance § Quantitative investing for a listing of relevant articles. For their pioneering work, Markowitz and Sharpe, along with Merton Miller, shared the 1990 Nobel Memorial Prize in Economic Sciences, for the first time ever awarded for a work in finance. The portfolio-selection work of Markowitz and Sharpe introduced mathematics to investment management. With time, the mathematics has become more sophisticated. Thanks to Robert Merton and Paul Samuelson, one-period models were replaced by continuous time, Brownian-motion models, and the quadratic utility function implicit in mean–variance optimization was replaced by more general increasing, concave utility functions.[11] Furthermore, in recent years the focus shifted toward estimation risk, i.e., the dangers of incorrectly assuming that advanced time series analysis alone can provide completely accurate estimates of the market parameters.[12] See Financial risk management § Investment management. Much effort has gone into the study of financial markets and how prices vary with time. Charles Dow, one of the founders of Dow Jones & Company and The Wall Street Journal , enunciated a set of ideas on the subject which are now called Dow Theory. This is the basis of the so-called technical analysis method of attempting to predict future changes. One of the tenets of "technical analysis" is that market trends give an indication of the future, at least in the short term. The claims of the technical analysts are disputed by many academics.[citation needed] Criticism The aftermath of the financial crisis of 2009 as well as the multiple Flash Crashes of the early 2010s resulted in social uproars in the general population and ethical malaises in the scientific community which triggered noticeable changes in Quantitative Finance (QF). More specifically, mathematical finance was instructed to change and become more realistic as opposed to more convenient. The concurrent rise of Big data and Data Science contributed to facilitating these changes. More specifically, in terms of defining new models, we saw a significant increase in the use of Machine Learning overtaking traditional Mathematical Finance models.[13] Over the years, increasingly sophisticated mathematical models and derivative pricing strategies have been developed, but their credibility was damaged by the financial crisis of 2007–2010. Contemporary practice of mathematical finance has been subjected to criticism from figures within the field notably by Paul Wilmott, and by Nassim Nicholas Taleb, in his book The Black Swan.[14] Taleb claims that the prices of financial assets cannot be characterized by the simple models currently in use, rendering much of current practice at best irrelevant, and, at worst, dangerously misleading. Wilmott and Emanuel Derman published the Financial Modelers' Manifesto in January 2009[15] which addresses some of the most serious concerns. Bodies such as the Institute for New Economic Thinking are now attempting to develop new theories and methods.[16] In general, modeling the changes by distributions with finite variance is, increasingly, said to be inappropriate.[17] In the 1960s it was discovered by Benoit Mandelbrot that changes in prices do not follow a Gaussian distribution, but are rather modeled better by Lévy alpha-stable distributions.[18] The scale of change, or volatility, depends on the length of the time interval to a power a bit more than 1/2. Large changes up or down are more likely than what one would calculate using a Gaussian distribution with an estimated standard deviation. But the problem is that it does not solve the problem as it makes parametrization much harder and risk control less reliable.[14] Perhaps more fundamental: though mathematical finance models may generate a profit in the short-run, this type of modeling is often in conflict with a central tenet of modern macroeconomics, the Lucas critique - or rational expectations - which states that observed relationships may not be structural in nature and thus may not be possible to exploit for public policy or for profit unless we have identified relationships using causal analysis and econometrics.[19] Mathematical finance models do not, therefore, incorporate complex elements of human psychology that are critical to modeling modern macroeconomic movements such as the self-fulfilling panic that motivates bank runs. See also See also: Outline of finance#Mathematical tools, Outline of finance#Derivatives pricing, and Outline of corporate finance Derivatives pricing Portfolio modeling Other Notes ↑ "Quantitative Finance". About.com. ↑ Lam, Leslie P. Norton and Dan. "Why Edward Thorp Owns Only Berkshire Hathaway" (in en-US). ↑ Johnson, Tim (1 September 2009). "What is financial mathematics?". +Plus Magazine. ↑ E., Shreve, Steven (2004). Stochastic calculus for finance. New York: Springer. ISBN 9780387401003. OCLC 53289874. ↑ Stephen., Blyth (2013). Introduction to Quantitative Finance.. Oxford University Press, USA. pp. 157. ISBN 9780199666591. OCLC 868286679. ↑ B., Schmidt, Anatoly (2005). Quantitative finance for physicists : an introduction. San Diego, Calif.: Elsevier Academic Press. ISBN 9780080492209. OCLC 57743436. ↑ Bachelir, Louis. "The Theory of Speculation". ↑ Lindbeck, Assar. "The Sveriges Riksbank Prize in Economic Sciences in Memory of Alfred Nobel 1969-2007". 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However, most financial professionals only need basic knowledge in algebra and simple rules such as the order of operations to excel in their jobs. What's most important is being fast with basic math, and having a critical mind to understand the theory behind the concepts. In short, financial analysts are numbers people, so you need to be comfortable working with percentages, basic statistics (i.e averages & standard deviation), exponents, and algebraic expressions that reach the complexity of sigma notation (∑) and mathematical roots (√). In addition, quick mental calculations are always a huge plus. Don't worry too much about them now since you'll learn on the job. Just make sure you understand the theory behind them. Even so, for referential purposes, some common mathematical concepts in finance include: Net Present Value: NPV = ∑(CF/(1-r)^n), where CF is the net cash flows of each future period, r is the discount rate, and n is the number of periods.Loan Payments: LP = r*CP+r*OI, where IP is loan payment, r is the interest rate, CP is the current portion of the total principle amount due, and OI is any outstanding interest to be paid. This formula varies by loan type, as some loan types, such as accrued loans, do not charge interest on out standing interestRemaining Principle: RP = TP – CP, where RP is remaining principle, TP is total principle remaining, and CP is current portion of the total principle amount due.Cost of Capital: E(Ri) = Rf + βi * [E(Rm) – Rf], where E(Ri) is the expected return on asset i, Rf is the risk-free rate of return, βi is the beta of asset i, and E(Rm) is the expected market return.Ratios: target metric/global metric, where the target metric is a number from the financial statements and the global metric is a big number from the financial statements, like revenue. Examples of financial ratios include net profit margin, which is net profit/revenue. As you can see, the math itself is not difficult — it's just basic algebra. The more challenging part is understanding the concepts behind these calculations, and how to identify and apply them quickly. But don't worry, nobody knows how to do this coming out of school. It just takes practice. That said, we can explore the mathematical skills needed by type of financial analyst, which we will explore next. This article outline math needed in finance. To learn these skills, sign up to receive our cheat sheet below. We can break down Financial Analyst Roles into corporate types and investment banking types. I spoke with 2 corporate analysts and 3 financial analysts to find out what math skills they estimate most important for each role. Not surprisingly, they all mentioned the same overarching ideas. All but 1 of the 5 listed skills that were not strictly math related, so I've excluded those as they're outside the scope of this article. All 5 mentioned was the importance of Microsoft Excel as a crucial tool in their arsenal. Note: if you're deciding which to become, another element to consider for these roles is stress. Corporate financial analysts need to be familiar with the following math skills: Financial statements ratio analysisValuation techniques such as NPV and DCFPercentagesMultiplication, division, addition, subtractionBasic statisticsBasic probabilityMental mathSanity checks and intuition Basic statisticsBasic probabilityMental mathSanity checks and intuition Ratio analysisNPV and DCFPercentagesMultiplication, division, addition, subtractionBasic statisticsBasic probabilityMental mathSanity checks and intuition The last point for both analysts is sanity checks and intuition. A sanity check is the application of intuitive reference points to results to check if your results are "sane." For example, after you crunch down and map out a huge general ledger into an income statement (aka P&L), you should intuitively see if the net profit and revenue "make sense." Sanity checks are more and more important in a finance world that increasingly revolves around big data. Financial analysts are no longer expected to manage only accounting data and other strictly-financial data, but also commercial data that comes from digitized transaction recording. Any online shop, for example, tracks transactions as they occur, although accountants only record the data when they manually review and input it into the company's general ledger. When financial analysts crunch millions of lines of commercial transaction data, they need to be highly skilled at intuitively estimating if that data makes sense with sanity checks. As we've explored briefly, math is not the most challenging aspect of a financial analyst's role. The more difficult aspect is the logic and theory behind financial statements and different instruments, such as debt. A large part of the reason why calculations themselves are not a challenge is the efficiency and ubiquity of Microsoft Excel in financial fields. Excel allows you to make quick calculations with a high degree of accuracy and create models to explore the impact of multiple variables on a set of complex mathematical relationships. For example, you can easily and with great precision model a loan amortization schedule. For many traditional financial calculations, which are very complex by hand, Excel has built-in formulas and reverse-engineering functions to help you get results fast. For example, Excel's PMT() function allows you to rapidly calculate a traditional mortgage loan payment based on the interest rate, the number of payment periods, and the present value of the principle amount. Personally, I have tried to do this manually for the heck of it. It is possible, but very difficult. Another example is Excel's "What if" functions. The Goal Seek function, for example, allows you to set up a complex set of relationships, such as the calculation of a net salary based on social security contribution and a marginal tax rate, then simply reverse-engineer the calculation to find out what gross salary an employee needs to make to achieve a desired net salary. This may sound complicated — don't worry. Yes, someone who is bad at math can work in finance as long as she/he is a good logical thinker.. If by "bad at math" we mean prone to making calculation errors, or weak in mental math, the answer is of course. Microsoft Excel takes care of that for you. Even those who are good with calculations and mental math use Excel to avoid errors. My first boss was a very talented financial thinker, but he always used Excel for his exercises. However, if someone is a poor logical or critical thinker, Excel cannot help him/her be a successful financial analyst. We've discussed math for finance as separate from the logic and theory behind financial statements and financial instruments, but there is a special branch of mathematics called financial mathematics that explores these topics in depth. It uses advanced mathematical techniques to solve financial problems. Examples of advanced math include: Probability,Statistics,Stochastic processes,andEconomic theory However, financial math is more of an academic discipline than an industry skillset. While many financial institutions — especially investment banks — have Research & Development departments that use quantitative finance and "normal" finance is akin to the difference between R&D departments and client-facing roles in an investment bank. Quantitative finance uses financial mathematics to create profits for a firm, whereas "normal" finance employs algebraic expressions and order of operations to make quick decisions on the client-side. Obviously the R&D departments are looking for new opportunities on the financial markets, which means they need to pioneer new methodologies for calculating aged-old probability problems to make decisions. These teams, thus, usually consist of profiles with PHDs in mathematical fields. On the other hand, traditional financial analysts don't need to reinvent the wheel. They just need to make quick, accurate decisions that generate money for the firm or company as soon as possible. If finance interest you but you're not good at calculations or mental math, don't let it hold you back. I personally don't consider myself "strong" in math, and I don't have a degree in a mathematical field. However, I landed my job into an M&A field as a first job. After a year of practice, I made the leap into data-heavy corporate financial analyst roles — and all of this right out of college. Success as a financial analyst depends much more on critical thinking skills with are easy to learn than mathematical skills. In fact, that's why I started AnalystAnswers.com — to give analysts and potential analysts the tools and skills they need to succeed in their careers. These core skills today are data, financial, and business analysis. At the end of the day, Excel saves us all. But if you really want to be good at calculations and mental math, consider checking out some of the resources on this website. It's all about practice, practice, practice. Whatever interests you, start with solid basics, be confident, and work hard. This is what it takes to succeed as a financial analyst — not being "good at math." Finance is a broad field that encompasses the management of money, investments, and financial assets. It involves analyzing financial data, making investment decisions, and managing risk. Quantitative Finance, on the other hand, is a specialized branch of finance that focuses on using mathematical and statistical models to analyze financial markets and make investment decisions. Quantitative finance professionals use advanced mathematical techniques to develop models that can predict market trends and optimize investment strategies. While both fields involve managing financial assets, quantitative finance is more focused on using quantitative models to make informed decisions in the financial markets. Finance and Quantitative Finance are two closely related fields that deal with the management of money and investments. While both fields deal with financial data and make investment decisions, there are some key differences between the two. In this article, we will compare the attributes of Finance and Quantitative Finance to help you understand the distinctions between the two disciplines.FinanceFinance is a broad field that encompasses the management of money, investments, and other financial assets. Professionals in finance focus on making strategic decisions to maximize the value of investments and manage risks effectively. Finance professionals often work in areas such as banking, corporate finance, investment management, and financial planning.One of the key attributes of Finance is its focus on qualitative analysis. Finance professionals rely on their judgment, experience, and intuition to make decisions about investments and financial strategies. They consider factors such as market trends, economic conditions, and company performance to guide their decision-making process.Another important aspect of Finance is its emphasis on communication and relationship-building. Finance professionals often work closely with clients, colleagues, and other stakeholders to understand their financial goals and develop customized solutions. Strong communication skills are essential for success in the field of finance.Finance also involves a significant amount of risk management. Professionals in finance must assess and mitigate risks associated with investments, financial transactions, and market fluctuations. They use various tools and techniques to manage risks effectively and protect the financial interests of their clients or organizations.In summary, Finance is a diverse field that involves managing money, investments, and financial assets through qualitative analysis, communication, and risk management.Quantitative FinanceQuantitative Finance, on the other hand, is a specialized field that combines finance with mathematics, statistics, and computer science. Professionals in Quantitative Finance use quantitative methods and models to analyze financial data, develop investment strategies, and manage risks. Quantitative Finance is often used in areas such as algorithmic trading, financial engineering, and risk management.One of the key attributes of Quantitative Finance is its focus on quantitative analysis. Professionals in this field use mathematical models, statistical techniques, and computer algorithms to analyze financial data and make data-driven decisions. Quantitative Finance relies heavily on data analysis and mathematical modeling to identify patterns, trends, and opportunities in the financial markets.Another important aspect of Quantitative Finance is its emphasis on technology and programming. Professionals in this field use programming languages such as Python, R, and C++ to develop and implement quantitative models, algorithms, and trading strategies. Strong programming skills are essential for success in the field of Quantitative Finance.Quantitative Finance also involves a high level of complexity and sophistication in its analysis and decision-making processes. Professionals in this field must have a deep understanding of advanced mathematical concepts, statistical models, and financial theories to develop effective quantitative models and strategies. Quantitative Finance requires a strong analytical mindset and problem-solving skills.In summary, Quantitative Finance is a specialized field that combines finance with mathematics, statistics, and computer science to analyze financial data, develop investment strategies, and manage risks through quantitative analysis and technology.ComparisonFinance focuses on qualitative analysis, while Quantitative Finance emphasizes quantitative analysis.Finance relies on judgment and intuition, while Quantitative Finance relies on mathematical models and algorithms.Finance emphasizes communication and relationship-building, while Quantitative Finance emphasizes technology and programming.Finance involves risk management through qualitative assessment, while Quantitative Finance involves risk management through quantitative analysis.Finance is a broad field that encompasses various areas such as banking, corporate finance, and financial planning, while Quantitative Finance is a specialized field that focuses on mathematical modeling, statistical analysis, and computer programming.ConclusionIn conclusion, Finance and Quantitative Finance are two distinct fields that share some similarities but also have significant differences. Finance focuses on qualitative analysis, communication, and relationship-building, while Quantitative Finance emphasizes quantitative analysis, technology, and programming. Both fields play a crucial role in the management of money, investments, and financial assets, but they approach these tasks from different perspectives. Understanding the attributes of Finance and Quantitative Finance can help individuals choose the right path for their career in the financial industry. Comparisons may contain inaccurate information about people, places, or facts. Please report any issues. Part of a series onFinance Markets Assets Asset (economics) Bond Asset growth Capital asset Commodity Derivatives Domains Equity Foreign exchange Money Over-the-counter Private equity Real estate Spot Stock Participants Angel investor Bull (stock market speculator) Financial planner Investor institutional Retail Speculator Locations Financial centres Offshore financial centres Conduit and sink OFCs Instruments Bond Cash Collateralised debt obligation Credit default swap Time deposit (certificate of deposit) Credit line Deposit Derivative Futures contract Indemnity Insurance Letter of credit Loan Mortgage Option (callexoticput) Performance bonds Repurchase agreement Stock Security Syndicated loan Synthetic CDO Corporate General Accounting Audit Capital budgeting Capital structure Corporate finance Credit rating agency Enterprise risk management Enterprise value Risk management Financial statements Transactions Leveraged buyout Mergers and acquisitions Structured finance Venture capital Taxation Base erosion and profit shifting (BEPS) Corporate tax haven Tax inversion Tax haven Transfer pricing Personal Credit / Debt Employment contract Financial planning RetirementStudent loan Public Government spending Final consumption expenditure OperationsRedistribution Transfer payment Government revenue TaxationDeficit spending Budget (balance)Debt Non-tax revenue Warrant of payment Banking Central bank Deposit account Fractional-reserve Full-reserve Investment banking Loan Money supply Lists of banks Bank regulation Banking license Basel Accords Bank for International Settlements Financial Stability Board Deposit insurance Separation of investment and retail banking Regulation · Financial law International Financial Reporting Standards ISO 31000 Professional certification Fund governance Economic history Private equity and venture capital Recession Stock market bubble Stock market crash Accounting scandals Outline Business and Economics portal Money portalvte Application of mathematical and statistical methods in finance Mathematical finance, also known as quantitative finance and financial mathematics, is a field of applied mathematics, concerned with mathematical modeling in the financial field. In general, there exist two separate branches of finance that require advanced quantitative techniques: derivatives pricing on the one hand, and risk and portfolio management on the other.[1] Mathematical finance overlaps heavily with the fields of computational finance and financial engineering. The latter focuses on applications and modeling, often with the help of stochastic asset models, while the former focuses, in addition to analysis, on building tools of implementation for the models. Also related is quantitative investing, which relies on statistical and numerical models (and lately machine learning) as opposed to traditional fundamental analysis when managing portfolios. French mathematician Louis Bachelier's doctoral thesis, defended in 1900, is considered the first scholarly work on mathematical finance. But mathematical finance emerged as a discipline in the 1970s, following the work of Fischer Black, Myron Scholes and Robert Merton on option pricing theory. Mathematical investing originated from the research of mathematician Edward Thorp who used statistical methods to first invent card counting in blackjack and then applied its principles to modern systematic investing.[2] The subject has a close relationship with the discipline of financial economics, which is concerned with much of the underlying theory that is involved in financial mathematics. While trained economists use complex economic models that are built on observed empirical relationships, in contrast, mathematical finance analysis will derive and extend the mathematical or numerical models without necessarily establishing a link to financial theory, taking observed market prices as input. See: Valuation of options; Financial modeling; Asset pricing. The fundamental theorem of arbitrage-free pricing is one of the key theorems in mathematical finance, while the Black–Scholes equation and formula are amongst the key results.[3] Today many universities offer degree and research programs in mathematical finance. There are two separate branches of finance that require advanced quantitative techniques: derivatives pricing, and risk and portfolio management. One of the main differences is that they use different probabilities such as the risk-neutral probability (or arbitrage-pricing probability), denoted by "Q", and the actual (or actuarial) probability, denoted by "P". The Q world Goal "extrapolate the present" Environment risk-neutral probability Q {\displaystyle \mathbb {Q} } Processes continuous-time martingales Dimension low Tools Itō calculus, PDEs Challenges calibration Business sell-side Main article: Risk-neutral measure Further information: Black–Scholes model, Brownian model of financial markets, Martingale pricing, and Quantitative analysis (finance) § History The goal of derivatives pricing is to determine the fair price of a given security in terms of more liquid securities whose price is determined by the law of supply and demand. The meaning of "fair" depends, of course, on whether one considers buying or selling the security. Examples of securities being priced are plain vanilla and exotic options, convertible bonds, etc. Once a fair price has been determined, the sell-side trader can make a market on the security. Therefore, derivatives pricing is a complex "extrapolation" exercise to define the current market value of a security, which is then used by the sell-side community. Quantitative derivatives pricing was initiated by Louis Bachelier in The Theory of

Speculation ("Théorie de la spéculation", published 1900), with the introduction of the most basic and most influential of processes, Brownian motion, and its applications to the pricing of options.[4][5] Brownian motion is derived using the Langevin equation and the discrete random walk.[6] Bachelier modeled the time series of changes in the logarithm of stock prices as a random walk in which the short-term changes had a finite variance. This causes longer-term changes to follow a Gaussian distribution.[7] The theory remained dormant until Fischer Black and Myron Scholes, along with fundamental contributions by Robert C. Merton, applied the second most influential process, the geometric Brownian motion, to option pricing. For this M. Scholes and R. Merton were awarded the 1997 Nobel Memorial Prize in Economic Sciences. Black was ineligible for the prize because he died in 1995.[8] The next important step was the fundamental theorem of asset pricing by Harrison and Pliska (1981), according to which the suitably normalized current price P0 of security is arbitrage-free, and thus truly fair only if there exists a stochastic process Pt with constant expected value which describes its future evolution:[9] P 0 = E 0 (P t) {\displaystyle P_{0}=\mathbf {E} _{0}(P_{t})} 1 A process satisfying (1) is called a "martingale". A martingale does not reward risk. Thus the probability of the normalized security price process is called "risk-neutral" and is typically denoted by the blackboard font letter " Q {\displaystyle \mathbb {Q} } ". The relationship (1) must hold for all times t: therefore the processes used for derivatives pricing are naturally set in continuous time. The quants who operate in the Q world of derivatives pricing are specialists with deep knowledge of the specific products they model. Securities are priced individually, and thus the problems in the Q world are low-dimensional in nature. Calibration is one of the main challenges of the Q world: once a continuous-time parametric process has been calibrated to a set of traded securities through a relationship such as (1), a similar relationship is used to define the price of new derivatives. The main quantitative tools necessary to handle continuous-time Q-processes are Itô's stochastic calculus, simulation and partial differential equations (PDEs).[10] The P world Goal "model the future" Environment real-world probability P {\displaystyle \mathbb {P} } Processes discrete-time series Dimension large Tools multivariate statistics Challenges estimation Business buy-side Risk and portfolio management aims to model the statistically derived probability distribution of the market prices of all the securities at a given future investment horizon. This "real" probability distribution of the market prices is typically denoted by the blackboard font letter " P {\displaystyle \mathbb {P} } ", as opposed to the "risk-neutral" probability " Q {\displaystyle \mathbb {Q} } " used in derivatives pricing. Based on the P distribution, the buy-side community takes decisions on which securities to purchase in order to improve the prospective profit-and-loss profile of their positions considered as a portfolio. Increasingly, elements of this process are automated; see Outline of finance § Quantitative investing for a listing of relevant articles. For their pioneering work, Markowitz and Sharpe, along with Merton Miller, shared the 1990 Nobel Memorial Prize in Economic Sciences, for the first time ever awarded for a work in finance. The portfolio-selection work of Markowitz and Sharpe introduced mathematics to investment management. With time, the mathematics has become more sophisticated. Thanks to Robert Merton and Paul Samuelson, one-period models were replaced by continuous time, Brownian-motion models, and the quadratic utility function implicit in mean–variance optimization was replaced by more general increasing, concave utility functions.[11] Furthermore, in recent years the focus shifted toward estimation risk, i.e., the dangers of incorrectly assuming that advanced time series analysis alone can provide completely accurate estimates of the market parameters.[12] See Financial risk management § Investment management. Much effort has gone into the study of financial markets and how prices vary with time. Charles Dow, one of the founders of Dow Jones & Company and The Wall Street Journal, enunciated a set of ideas on the subject which are now called Dow Theory. This is the basis of the so-called technical analysis method of attempting to predict future changes. One of the tenets of "technical analysis" is that market trends give an indication of the future, at least in the short term. The claims of the technical analysts are disputed by many academics.[citation needed] While numerous empirical studies have examined the effectiveness of technical analysis, there remains no definitive consensus on its usefulness in forecasting financial markets.[13] Further information: Financial economics § Challenges and criticism, and Financial engineering § Criticisms See also: Financial models with long-tailed distributions and volatility clustering Over the years, increasingly sophisticated mathematical models and derivative pricing strategies have been developed, but their credibility was damaged by the 2008 financial crisis. Contemporary practice of mathematical finance has been subjected to criticism from figures within the field notably by Paul Wilmott, and by Nassim Nicholas Taleb, in his book The Black Swan.[14] Taleb claims that the prices of financial assets cannot be characterized by the simple models currently in use, rendering much of current practice at best irrelevant, and, at worst, dangerously misleading. Wilmott and Emanuel Derman published the Financial Modelers' Manifesto in January 2009[15] which addresses some of the most serious concerns. Bodies such as the Institute for New Economic Thinking are now attempting to develop new theories and methods.[16] In general, modeling the changes by distributions with finite variance is, increasingly, said to be inappropriate.[17] In the 1960s it was discovered by Benoit Mandelbrot that changes in prices do not follow a Gaussian distribution, but are rather modeled better by Lévy alpha-stable distributions.[18] The scale of change, or volatility, depends on the length of the time interval to a power a bit more than 1/2. Large changes up or down are more likely than what one would calculate using a Gaussian distribution with an estimated standard deviation. But the problem is that it does not solve the problem as it makes parametrization much harder and risk control less reliable.[14] Perhaps more fundamental: though mathematical finance models may generate a profit in the short-run, this type of modeling is often in conflict with a central tenet of modern macroeconomics, the Lucas critique - or rational expectations - which states that observed relationships may not be structural in nature and thus may not be possible to exploit for public policy or for profit unless we have identified relationships using causal analysis and econometrics.[19] Mathematical finance models do not, therefore, incorporate complex elements of human psychology that are critical to modeling modern macroeconomic movements such as the self-fulfilling panic that motivates bank runs. See also: Outline of finance § Financial mathematics, Outline of finance § Mathematical tools, Outline of finance § Derivatives pricing, Outline of corporate finance, and Computational finance Asymptotic analysis Backward stochastic differential equation Calculus Copulas, including Gaussian Differential equations Expected value Ergodic theory Feynman–Kac formula Finance § Quantitative finance Fourier transform Girsanov theorem Itô's lemma Martingale representation theorem Mathematical models Mathematical optimization Linear programming Nonlinear programming Quadratic programming Monte Carlo method Numerical analysis Gaussian quadrature Real analysis Partial differential equations Heat equation Numerical partial differential equations Crank–Nicolson method Finite difference method Probability Probability distributions Binomial distribution Johnson's SU-distribution Log-normal distribution Student's t-distribution Quantile functions Radon–Nikodym derivative Risk-neutral measure Scenario optimization Stochastic calculus Brownian motion Lévy process Stochastic differential equation Stochastic optimization Stochastic volatility Survival analysis Value at risk Volatility ARCH model GARCH model The Brownian model of financial markets Rational pricing assumptions Risk neutral valuation Arbitrage-free pricing Valuation adjustments Credit valuation adjustment XVA Yield curve modelling Multi-curve framework Bootstrapping Construction from market data Fixed-income attribution Nelson-Siegel Principal component analysis Forward Price Formula Futures contract pricing Swap valuation Currency swap#Valuation and Pricing Interest rate swap#Valuation and pricing Multi-curve framework Variance swap#Pricing and valuation Asset swap #Computing the asset swap spread Credit default swap #Pricing and valuation Options Put–call parity (Arbitrage relationships for options) Intrinsic value, Time value Moneyness Pricing models Black–Scholes model Black model Binomial options model Implied binomial tree Edgeworth binomial tree Monte Carlo option model Implied volatility, Volatility smile Local volatility Stochastic volatility Constant elasticity of variance model Heston model Stochastic volatility jump SABR volatility model Markov switching multifractal The Greeks Finite difference methods for option pricing Vanna–Volga pricing Trinomial tree Implied trinomial tree Garman-Kohlhagen model Lattice model (finance) Margrabe's formula Carr–Madan formula Pricing of American options Barone-Adesi and Whaley Bjerksund and Stensland Black's approximation Least Square Monte Carlo Optimal stopping Roll-Geske-Whaley Interest rate derivatives Black model caps and floors swaptions Bond options Short-rate models Rendleman–Bartter model Vasicek model Ho–Lee model Hull–White model Cox–Ingersoll–Ross model Black–Karasinski model Black–Derman–Toy model Kalotay–Williams–Fabozzi model Longstaff–Schwartz model Chen model Forward rate-based models LIBOR market model (Brace–Gatarek–Musiela Model, BGM) Heath–Jarrow–Morton Model (HJM) Further information: Outline of finance § Portfolio theory, Outline of finance § Quantitative investing, and Outline of finance § Portfolio mathematics Computational finance Derivative (finance), list of derivatives topics Economic model Econophysics Financial economics Financial engineering Financial modeling § Quantitative finance International Association for Quantitative Finance International Swaps and Derivatives Association Index of accounting articles List of economists Master of Quantitative Finance Outline of economics Outline of finance Physics of financial markets Quantitative behavioral finance Quantum finance Rocket science (finance) Statistical finance Technical analysis XVA ^ "Quantitative Finance". 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