FinTech via the lens of Theory

Objectives:

- Students will be able to define institutional theory
- Students will be able to describe the three sources of influence for institutional behavior

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Institutional theory has long been used to study the creation of new ways of doing things, as well as the preservation and perpetuation of existing ones. The first generation of institutional theorists claimed that rational bureaucracies were responsible for structuring and, hence conducting business. As rational actors, these rational bureaucracies would reach the same conclusions about how—and why—businesses should be governed.

Any useful new technology introduced under this philosophy would be quickly embraced and disseminated throughout all organizations. Since a result, there would be little or no room for entrepreneurship, as established firms would rapidly and efficiently absorb any potentially revolutionary technology. The truth of organizations, however, is that not only are the people who manage them not entirely logical, but also new technology, especially those with unknown benefits, may take time to embrace.

As a result, a new generation of institutional theorists, known as neo-institutional theorists, began to look at institutionalization through a different lens: one that focused on an actor's cognition and the impacts of micro, meso, and macro-level norms on individuals and organizations. These thinkers emphasized the significance of cognitive processes in constructing organizations, particularly those involving norms and informational exchanges.

Eventually, when it came to perpetuating—and perhaps possibly reshaping—institutionalized behaviors, these new institutional theorists identified three sources of influence. Not only were there the necessary legislation, but also cognition and norms. Furthermore, these theorists highlighted the importance of many players in generating field changes.

Initial research highlighted the role of peripheral actors in driving change inside an institutional field, but more recent research has demonstrated how incumbent actors, particularly in economic activities, may be the ones to begin change. These four forces—regulations, cognition, norms, and external and internal actors—can be combined to better comprehend and investigate institutional change and industry transformation.

What is FinTech?

Objectives:

- Students will be able to provide a basic definition of FinTech
- Students will be able to describe common pathways for financial innovation to alter the market structure in financial services

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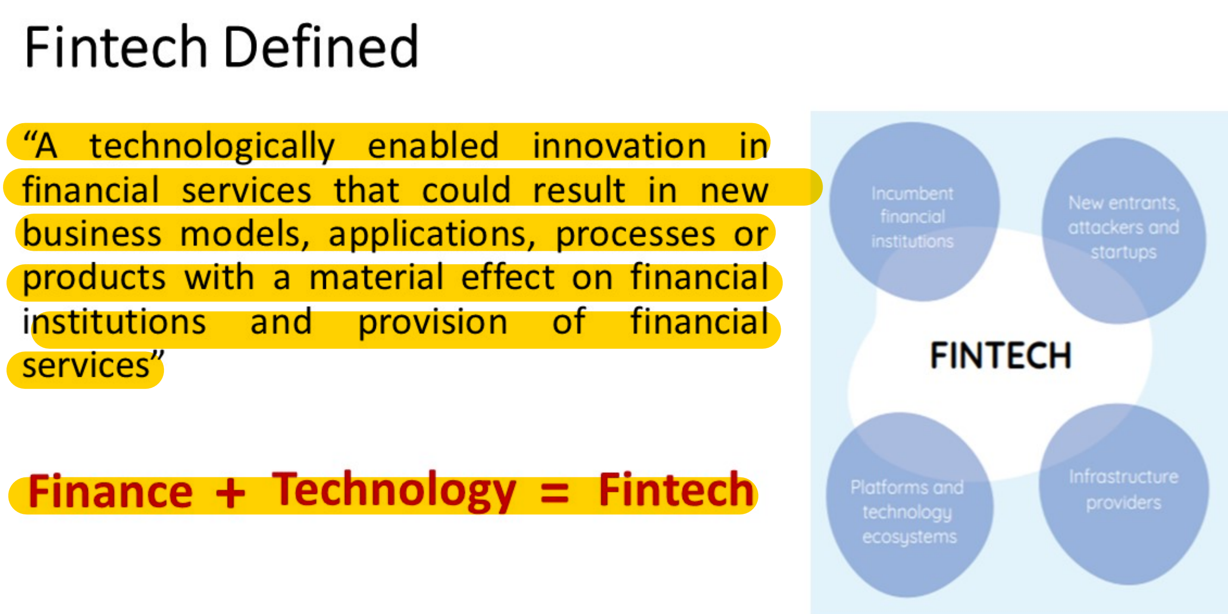

The application of technology for the provision of financial services is referred to as “financial technology” (or FinTech). FinTech is a term used to describe technology startups that are emerging to compete with traditional banking and financial market players, offering a variety of services ranging from mobile payment solutions and crowdfunding platforms to online portfolio management and international money transfers. FinTech businesses are gaining the attention of both customers of financial services and investment corporations, who regard them as the financial sector's future. FinTech can be defined as "technologically enabled financial innovation that may result in new business models, applications, procedures, or products that have a significant influence on financial markets and institutions, as well as the provision of financial services." In view of the present fluidity of FinTech advances, such a wide-angle description is considered helpful.

The above-mentioned understanding of FinTech can also give fresh perspectives on company models. Uber is a real-world example. According to the definition, Uber is a FinTech firm since it offers non-traditional (i.e., creative ideas) transportation services via the use of technology (i.e., mobile applications) to enhance taxi ordering (financial services). In reality, Uber offers “upfront pricing” in most locations, which means that the rider is given an estimate of how much the journey would cost before requesting it.

In other words, the proposed definition and extension of FinTech may be used as a creative reference in assisting firms in rethinking existing business models or even proposing new ventures. In the parts that follow, we'll go through how to use FinTech to produce commercial value.

FinTech can be considered as a regime change in terms of financial stability thinking. Its impact on financial stability could be so massive, that would alter the financial services market structure. Market structure refers to the interrelationships among firms in a market that influence their behavior and capacity to profit. The quantity and scale of market players, the obstacles to entry and departure, and the accessibility of information and technology to all participants are all aspects that define market structure. In some speculative circumstances, this might have an influence on the financial system's stability. Financial innovation has the potential to alter market structure in financial services through a variety of avenues, including:

1. The rise of bank-like service providers, such as FinTech credit or payments, which might have an influence on markets and bank behavior. In the long run, the increased efficiency of new players may improve the efficiency of financial services. The lack of legacy systems may also advantage newcomers. These changes may have an influence on banks' and other incumbent financial institutions' income sources, making them possibly more lucrative in certain cases, but also potentially more sensitive to losses and lowering retained earnings as a source of internal capital in others. This may have an influence on financial industry risk-taking and resilience. The rate at which new suppliers enter the market might have a big impact on how effectively incumbents react.
2. BigTech refers to the introduction of large, well-established technology companies into financial services. In several countries, non-traditional institutions with established networks and collected big data have gained a foothold in the financial services market, notably in payments, but also in credit, insurance, and wealth management. Increased rivalry with existing financial institutions might be a result of this as well. Because companies may utilize the data collected through these services for a range of industries, new BigTech firms could provide lower-cost (or even free) services. This, in turn, might have a variety of consequences for current markets.
3. Third-party supply of critical services. For data provision, physical connection, and cloud services, financial institutions rely on third-party service providers. Traditional financial institutions and FinTech businesses may become more reliant on third-party service providers over time. If systemically significant institutions or markets do not properly manage risks connected with third-party outsourcing at the

company level, systemic operational and cyber security concerns may develop.

In this context, market actors must innovate and offer interactive solutions on par with their FinTech counterparts if they want to attract lucrative clientele. This phenomenon has been further fueled by a nonstop increase in worldwide FinTech investment, mostly deriving from venture capital and private equity firms. London, San Francisco/Silicon Valley, and Additional York have already established themselves as significant financial innovation centers, with new hubs springing up all over the world, including Amsterdam, Berlin, Dublin, and Paris, which serve as the hubs for the European FinTech ecosystem.

History of FinTech

Objectives:

- Students will be able to identify the timelines for each of the three phases of the evolution of FinTech
- Students will be able to describe the key events and innovations within each of the three phases of the evolution of FinTech

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FinTech has become a popular subject in recent years, although the concept is not new. The first communication via the Trans-Atlantic transmission line occurred on August 16, 1958 and may be dated back to July 1866. The connection not only cut communication time between North America and Europe in half, from 10 days to 17 hours (when a message was sent by ship), but it also aided the creation of the global telex and subsequent financial services, which is also known as FinTech 1.0.

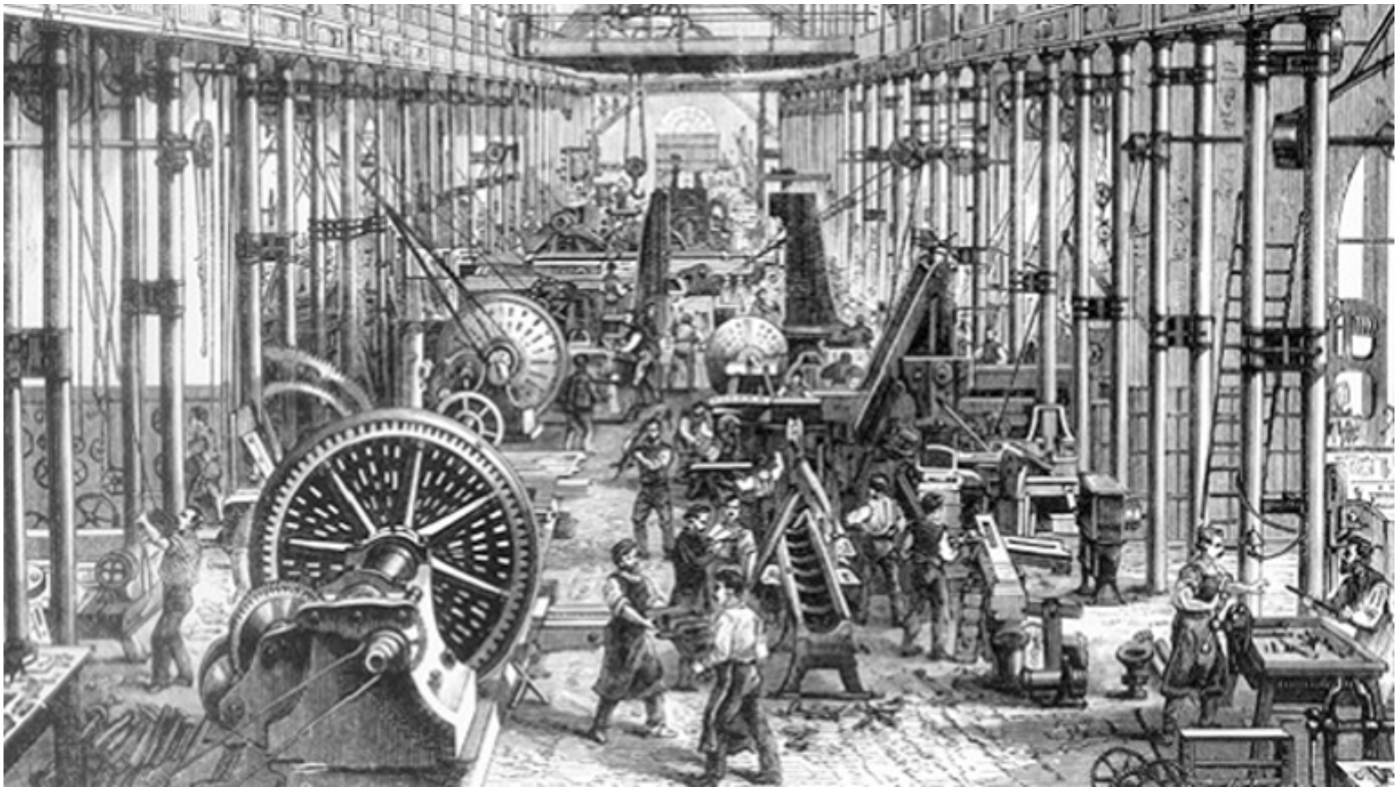
In essence, the advancement of FinTech is inextricably linked to the advancement of supporting technology. The Trans-Atlantic transmission line and mainframe computers, for example, were significant enabling technology during FinTech 1.0. These technologies give rise to financial technology products like SWIFT and ATMs. The Internet and the Internet of Things were among the associated technologies created during FinTech 2.0, but more and more data technologies will be developed during FinTech 3.0. We are currently in a time of transition between FinTech 2.0 and FinTech 3.0.

FinTech 1.0 (1866-1967)

Finance and technology, as previously stated, have long been intertwined and mutually reinforcing since their inception. Finance has its roots in administrative systems for state administration that were required throughout the shift from hunter-gatherer societies to established agricultural nations, such as in Mesopotamia, where some of the oldest examples of written records document financial transactions.

Thus, there has been a clear relationship between finance and technology, in this case stemming from the mutually reinforcing process of money and written records, one of the oldest kinds of information technology. Similarly, the evolution of money and finance are inextricably linked, with fiat currency (a technology that demonstrates transferable values) serving as one of the fundamental characteristics of the contemporary economy. The evolution of early tools for computation, such as the abacus, follows a similar pattern. Finance evolved from an early stage both to assist commerce (e.g., financing, and insuring ships and infrastructure such as bridges, railways, and canals) and to support the manufacture of products for that trade. The interwoven growth of banking and trade in the late Middle Ages and Renaissance gave rise to double entry accounting, another technology essential to a modern economy.

Many historians today believe that the late-1600s financial revolution in Europe, which included joint stock firms, insurance, and banking, was critical to the Industrial Revolution. Finance aided the development of technology that aided industrial progress in this setting.



Finance and technology came together in the late 1800s to create the first phase of financial globalization, which lasted until the outbreak of World War I. Technology such as the telegraph, railways, canals, and steamships supported financial interlinkages across boundaries at this time, allowing for the quick transfer of financial information, transactions, and payments throughout the world. At the same time, the financial industry had given the essential resources for the development of these technologies. In a 1920 article, J.M. Keynes painted a clear picture of the interconnection between finance and technology in this early era of financial globalization:

"The inhabitant of London could order by telephone, sipping his morning tea in bed, the various products of the whole earth, in such quantity as he might see fit, and reasonably expect their early delivery upon his door-step; he could at the same moment and by the same means adventure his wealth in the natural resources and new enterprises of any quarter of the world, and share, without exertion or even trouble."

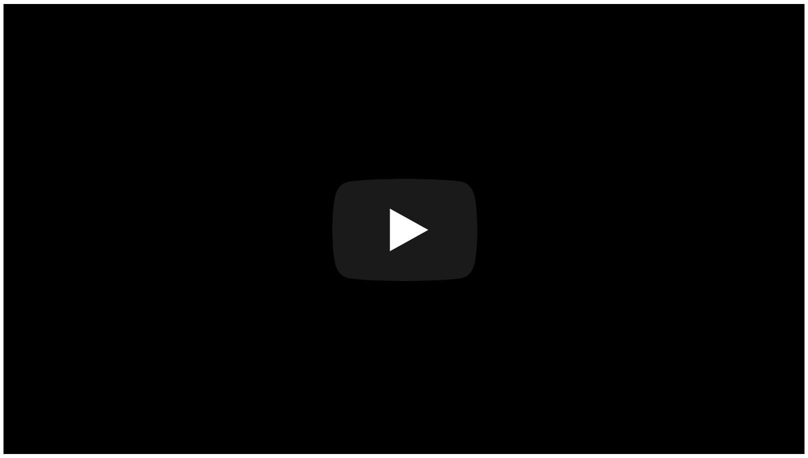
While financial globalization was slowed for several decades after WWII, technological advances, particularly those resulting from the conflict, advanced quickly, notably in communications and information technology. In the area of information technology, code-breaking techniques were commercially created and integrated into early computers by companies such as International Business Machines (IBM), while Texas Instruments introduced the portable financial calculator in 1967. The 1950s also saw the introduction of credit cards to the United States (Diners' Club in 1950, Bank of America and American Express in 1958). The founding of the Interbank Card Association (now MasterCard) in the United States in 1966 aided this consumer revolution. By 1966, a worldwide telex network had been established, providing the foundational communications on which the next stage of FinTech growth could be built. Long Distance Xerography was the first commercial version of the successor to the telex, the fax machine, launched by the Xerox Corporation in 1964. (LDX). As previously stated, Barclays launched the first ATM in the UK in 1967, and the combined impact of these innovations, in our opinion, marks the start of the FinTech 2.0 era.

FinTech 2.0 (1967-2008)

In 1967, the calculator and the ATM were introduced, ushering in the contemporary era of FinTech 2.0. From 1967 through 1987, the financial services sector transitioned from analogue to digital. The Inter-Bank Computer Bureau, which formed the basis of today's Bankers' Automated Clearing Services (BACS), was established in the UK in 1968, and the US Clearing House Interbank Payments System (CHIPS) was founded in 1970. Fedwire, which initially began in 1918 as a telegraphic system, transitioned to an electronic system in the early 1970s. The Society of Worldwide Interbank Financial Telecommunications (SWIFT) was founded in 1973 to address the need to connect domestic payments systems across borders, and the collapse of Herstatt Bank in 1974 highlighted the dangers of increasing international financial interlinkages, particularly through new payments system technology. This crisis prompted the first major regulatory emphasis on FinTech concerns, in the shape of a series of international soft law agreements on the development of reliable payment systems and related regulation.

The founding of NASDAQ in the United States in 1971, the abolition of fixed securities commissions, and the ultimate construction of the National Market System signaled the shift from physical securities trading, which dates back to the late 1600s, to entirely electronic securities trading today. Online banking was initially offered in the consumer sector in the United States in 1980 (before being abandoned in 1983) and in the United Kingdom in 1983 by the Nottingham Building Society (NBS).

On “Black Monday”, 1987, stock markets all across the world collapsed. The crash's consequences demonstrated how digitally interconnected global markets were through technology in a level not seen since the 1929 catastrophe. The worldwide reaction to the 1987 stock market crisis in the United States plainly foreshadowed key developments that laid the groundwork for the second phase of financial globalization. The hazards of cross-border financial linkages and their confluence with technology were brought to the attention of regulators for the first time. The picture of an investment banker brandishing an early mobile phone (first released in the US in 1983) is one of the most famous images from this time, as depicted in Oliver Stone's 1987 film Wall Street. As a result of the reaction, “circuit breakers” were introduced to regulate the pace of price fluctuations, and securities authorities throughout the globe developed procedures to encourage collaboration. In addition, the Single European Act of 1986 went into effect, establishing the framework for the European Union's (from 1992) establishment of a single financial market, and the UK's Big Bang financial liberalization process in 1986, combined with the 1992 Maastricht Treaty and an ever-increasing number of financial services Directives and Regulations from the late 1980s, set the foundation for the European Union's (from 1992) establishment of a single financial market.



The advent of the Internet, through the mid-1990s with Wells Fargo leveraging the World Wide Web (WWW) to enable online account checking, laid the foundation for the next phase of growth. By 2001, eight United States banks had at least one million customers online, and other major jurisdictions across the world were quickly establishing comparable systems and regulatory frameworks to manage risk. Banks' internal operations, communications with outsiders, and a rising number of interactions with retail consumers had all been fully digitized by the turn of the century, as seen by the financial services industry's significant IT expenditure. The internet supplied the underlying shift that made Fintech 3.0 feasible a decade later in the late 1990s. The new internet age gave birth to e-banking and all of Fintech 3.0's innovations.

Fintech 3.0 (2008–present)

The 2008 global financial crisis had a catalyzing effect on the growth of the FinTech sector. Around that time, a number of variables came together to provide developed nations the push for Fintech 3.0. Banks' reputations were severely tarnished at this time, particularly in the United Kingdom and the United States. According to the results of a recent poll, Americans trust technology companies more than banks with their money. The same phenomenon appears to occur in China, where numerous peer-to-peer (P2P) lending platforms chose to operate outside of a clear and well-defined regulatory framework. Nevertheless, this does not seem to deter millions of moneylenders and money-borrowers who are attracted to this choice, mainly due to the lower cost, and the possibility for ostensibly higher returns.

The regulation framework enacted after the 2008 world crisis, raised banks' compliance responsibilities/expenses along with imposing limitations in credit. Banks' incentives and capabilities to originate low-value loans have altered as a result of ring-fencing responsibilities and increasing regulatory capital. The new need to develop recovery and resolution plans as well as perform stress testing increased bank expenses even further.

“Silicon Valley is coming: There are hundreds of startups with a lot of brains and money working on various alternatives to traditional banking [...] They are very good at reducing the “pain points” in that they can make loans in minutes, which might take banks weeks.

Jamie Dimon CEO, JP Morgan

Fintech 3.0 distinguishes itself in two ways: first, who is providing financial services, with start-ups and technology corporations displacing banks in offering specialty services to the public, businesses, and banks; and second, the rate of development. In many countries, particularly in developing nations, there has been a shift in client perceptions of who has the resources and legitimacy to provide financial services, paired with an altogether new rate of evolution.

Fintech 3.0 is leveraging emerging technologies to drive innovation and massive digital transformation. The 2008 financial crisis was also an inspiration for the first decentralized, peer-to-peer, digital currency. Bitcoin was invented by an entity known as Satoshi Nakimoto in 2008. Since then, it has become a multi-trillion dollar digital asset. Bitcoin was the first global financial asset to enable completely decentralization and democratization. No government, bank, or individual could control it and that way was very powerful. Years later as blockchain technologies developed, the world of decentralized finance has more than $50 billion in assets locked in distributed platforms--giving individuals access to financial services without a central authority. The movement toward financial services democratization and an uncoupling of centralized financial institution monopolies is now becoming inevitable.

Bitcoin: A Peer-to-Peer Electronic Cash System

Satoshi Nakamoto
satoshin@gmx.com
www.bitcoin.org

Abstract. A purely peer-to-peer version of electronic cash would allow online payments to be sent directly from one party to another without going through a financial institution. Digital signatures provide part of the solution, but the main benefits are lost if a trusted third party is still required to prevent double-spending. We propose a solution to the double-spending problem using a peer-to-peer network. The network timestamps transactions by hashing them into an ongoing chain of hash-based proof-of-work, forming a record that cannot be changed without redoing the proof-of-work. The longest chain not only serves as proof of the sequence of events witnessed, but proof that it came from the largest pool of CPU power. As long as a majority of CPU power is controlled by nodes that are not cooperating to attack the network, they'll generate the longest chain and outpace attackers. The network itself requires minimal structure. Messages are broadcast on a best effort basis, and nodes can leave and rejoin the network at will, accepting the longest proof-of-work chain as proof of what happened while they were gone.

History of Fintech

	1866-1967 FinTech 1.0	1967-2008 FinTech 2.0	2008-current FinTech 3.0	2008-current FinTech 3.5
GEOGRAPHY	Global / Developed	Global / Developed	Developed	Emerging / Developing
KEY ELEMENTS	Infrastructure / computerisation Developed	Traditional / Internet	Mobile / Start-ups / New entrants	Mobile / Start-ups / New entrants
SHIFT ORIGIN	Linkages	Digitalization	2008 financial crisis / smartphone	Last mover advantatges

Fintech 1.0 (1866-1967) Infrastructure

1958: Credit cards - American Express Company

1967: Introduction of ATM by Barclays bank

Fintech 2.0 (1968-2008) Banks

Shift from analog to digital and is led by traditional financial institutions

Key Events

1967: Launch of the first handheld calculator

1971: Establishment of NASDAQ

1973: SWIFT was established

Fintech 2.0 (1968-2008) Banks

1980: Online Banking was introduced

1990: Internet and e-commerce business models

"Banks' internal processes, interactions with outsiders and retail customers had become fully digitized, beginning of the 21st century"

Fintech 3.0 (2008-Current) Start-ups

- With the GFC the general public developed a distrust of the traditional banking system which led to a shift in mindset and paved a way to a new industry, Fintech 3.0
- This era is marked by the emergence of new players alongside the already existing ones (such as banks)

Key Events

2009: Release of Bitcoin v0.1

2011: Google wallet was introduced

2014: Apple pay launched

Fintech 3.5 (2008-Current) Emerging Markets

- As of 2019, the countries with the highest Fintech usage are China (87%) and India (87%)
- China, India and other emerging markets never had time to develop Western levels of physical banking infrastructure, which has left them more open to new solutions

Key Events

2007: M-Pesa introduced in Kenya

2010: Alibaba introduces loans to SMEs on its e-commerce platform

2011: LuFax, an online Internet finance marketplace, is created

The Evolution of Fintech - Paper Highlights

The following are a few short paragraphs from a seminal paper by Key Opinion Leaders in the FinTech Industry. The three contributing authors to this 2015 paper have gone on to publish and present these ideas in many more follow up articles and lectures in many respected journals. It has been cited nearly 1,000 times, and prompted many responses.

While it would be too much to read the entire 44 page article, we hope the following few paragraphs help to answer "What is FinTech" and better appreciate why these authors made the distinction between 3 separate eras.

1. Introduction “Financial technology” or “FinTech” refers to the use of technology to deliver financial solutions. The term’s origin can be traced to the early 1990s and referred to the “Financial Services Technology Consortium”, a project initiated by Citigroup to facilitate technological cooperation efforts. However, it is only since 2014 that the sector has attracted the focused attention of regulators, industry participants and consumers alike. The term now refers to a large and rapidly growing industry representing between US$12 billion and US$197 billion in investment as of 2014, depending on whether one considers start-ups (FinTech 3.0) only or the full spectrum of applications, including traditional financial institutions (FinTech 2.0). This rapid growth has attracted greater regulatory scrutiny, which is certainly warranted given the fundamental role FinTech plays in the functioning of finance and its infrastructure. FinTech today is often seen as a uniquely recent marriage of financial services and information technology. However, the interlinkage of finance and technology has a long history. In fact, financial and technological developments have long been intertwined and mutually reinforcing. The Global Financial Crisis (GFC) of 2008 was a watershed and is part of the reason FinTech is now evolving into a new paradigm. This evolution poses challenges for regulators and market participants alike, particularly in balancing the potential benefits of innovation with the potential risks. The challenge of this balancing act is nowhere more acute than in the developing world, particularly Asia.

... ...
(page 4)

It is important to distinguish three main eras of FinTech evolution. From around 1866 to 1967, the financial services industry, while heavily interlinked with technology, remained largely an analogue industry, at least in public perception, a period which we characterize as FinTech 1.0. From 1967, the development of digital technology for communications and processing of transactions increasingly transformed finance from an analogue to a digital industry. By 1987 at the latest, financial services at least in developed countries had become not only once again highly globalized, but also digitalized. This period, which we characterize as FinTech 2.0, continued until 2008. During this period, FinTech was dominated primarily by the traditional regulated financial services industry that used technology to provide financial products and services. However, since 2008 (the period we characterize as FinTech 3.0) this is no longer necessarily the case. New start-ups and established technology companies have begun to deliver financial products and services directly to businesses and the general public.

... ...
(page 15)

FinTech today comprises five major areas: (1) finance and investment, (2) operations and risk management, (3) payments and infrastructure, (4) data security and monetization, and (5) customer interface.

A, Douglas, et al. (2015). **The Evolution of Fintech: A New Post-Crisis Paradigm?**. UHK Faculty of Law Research Paper No. 047. http://dx.doi.org/10.2139/ssrn.2676553

Understanding the FinTech Ecosystem

Objective:

- Students will read and understand the myriad actors involved in the FinTech Ecosystem

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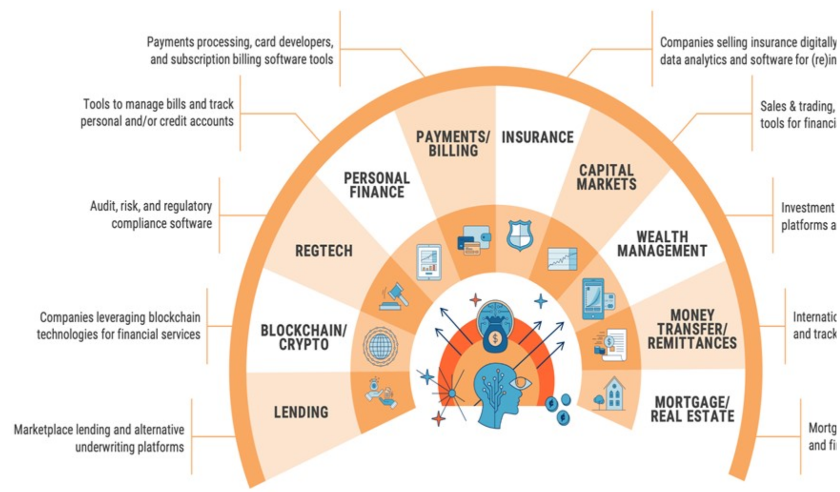
Fintech Eco-system



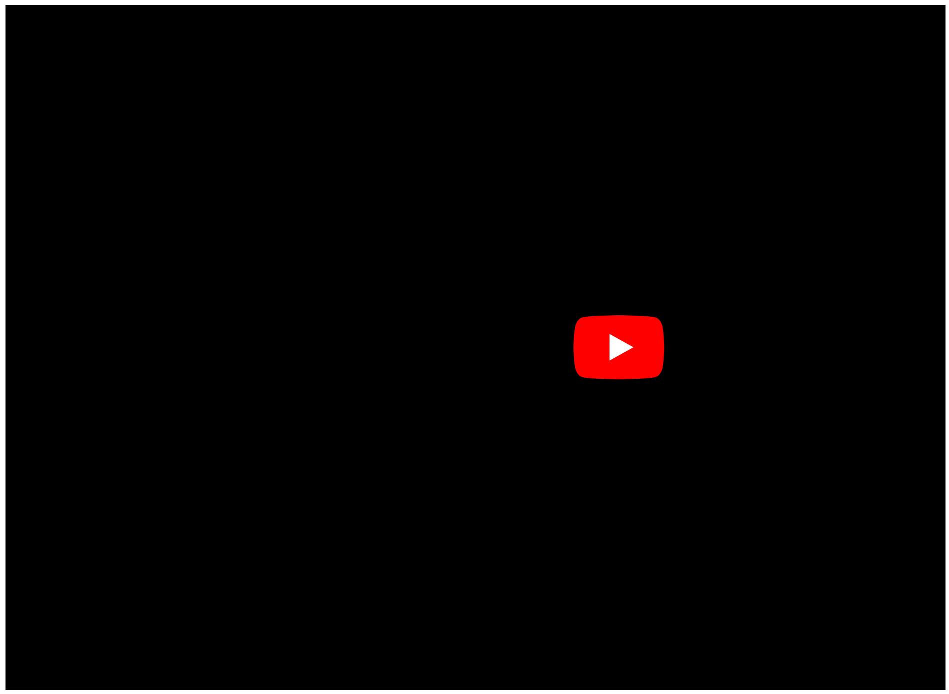
CB Insights

Why do we need FinTech?

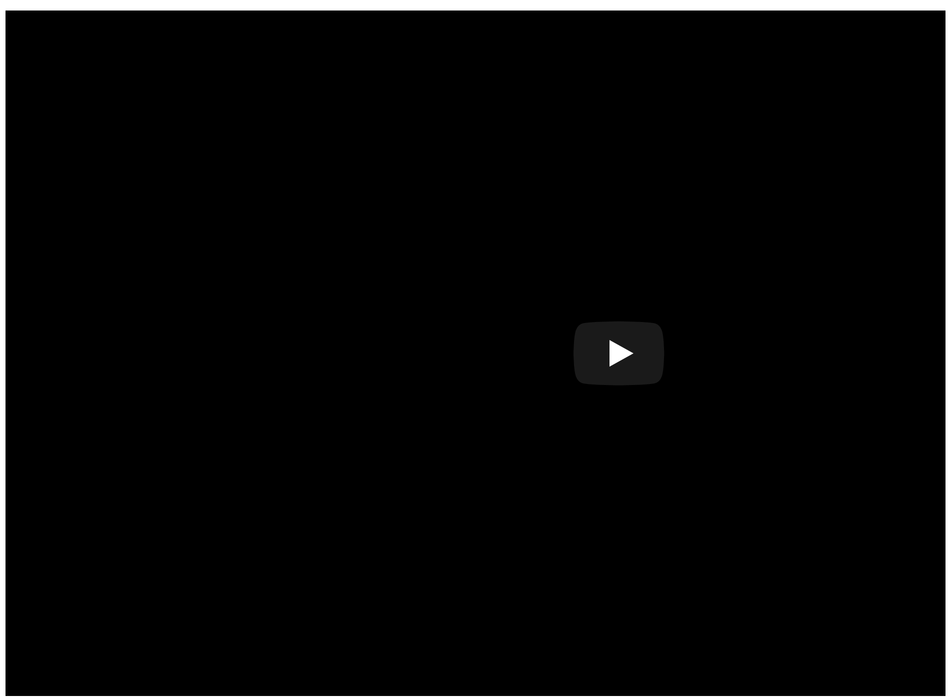
Objective:

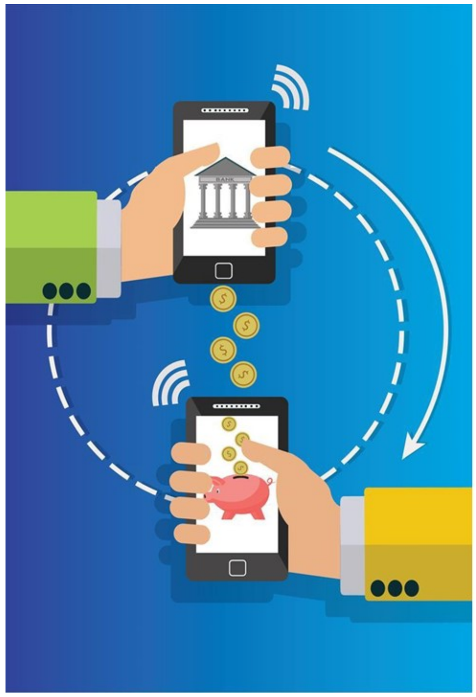
- Students will understand the concept of social impact
- Students will understand how FinTech can serve as an enabler for financial inclusion

Economic Instability in Lebanon



The Social Disease of Financial Exclusion





Financial Inclusion

- It is an effort to make everyday
available to more of the world's
reasonable cost. A key enab
poverty and boosting prosperity.
- Advancements in fintech, s
transactions, are making financia
to achieve

**"World Bank estimates tha
billion adults worldwide still
even a basic bank acc**

Why Fintech ?

Financial Inclusion : 1.4 billion people unbanked, M-PESA

Cost Effectiveness: No Physical Branches, No Middle Man,

Empowers small business: Faster to market , Stripe

1. Fintech Programm... 100% (/m/329/8921)
FinTech via the lens of T... (/m/
What is Fintech? (/m/
History of FinTech (/m/
The Evolution of Fintech... (/m/
Discovering FinTech Res... (/m/
Fintech Ecosystem (/m/
Why do we need fintech (/m/
Technologies Involved (/m/
The KSA FinTech Market... (/m/
Quiz - FinTech Evolution (/m/
Chapter Survey (/m/
2. Disruption, Disint... 100% (/m/329/8922)
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4. Policies 100% (/m/329/8924)
5. Review, Discussio... 100% (/m/329/8925)

How Technologies Impact the Adoption of FinTech

Objective:

- Students will define what a digital currency is
- Students will be able to describe the impact of mobile phone technology on both FinTech in ger

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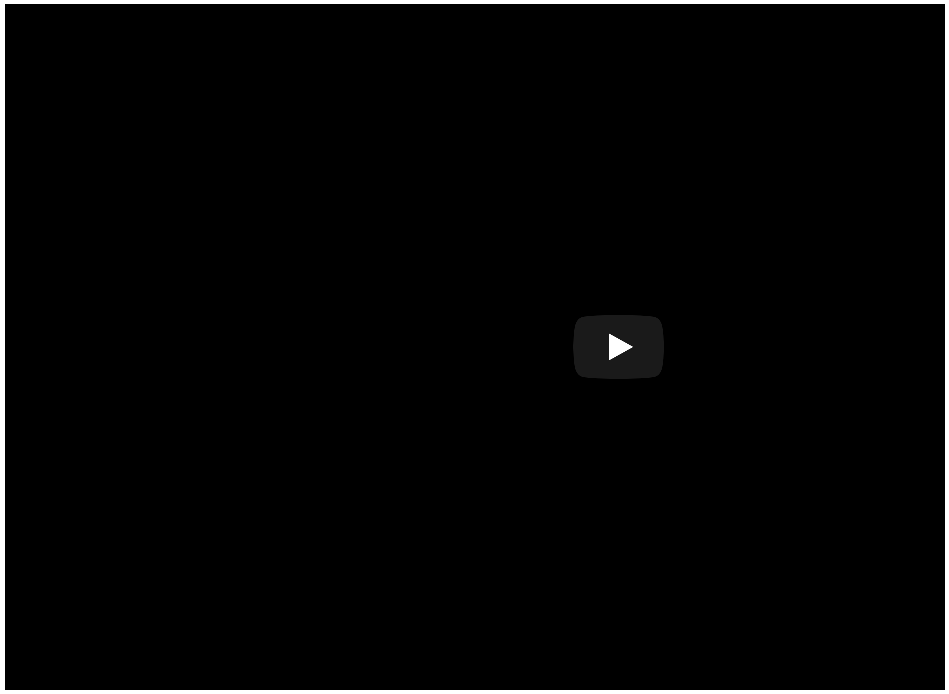
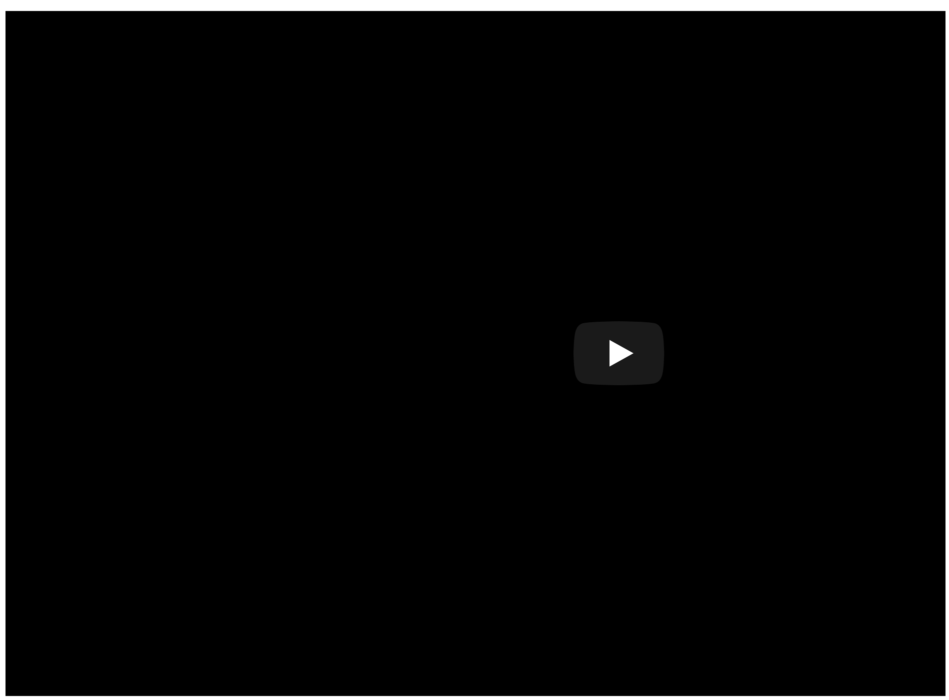
Digital Currency in the Bahamas



How M-Pesa enables Financial Inclusion in Africa



Technologies Involved

INTERNET

TELECOM

BLOCKCHAIN

AI

PREVIOUS (/M/329/8921/67978)

Innovative Forces in Finance

Objectives:

- Students will be able to identify the most important aspects of financial services
- Students will be able to discuss the eight forces have the potential to shift the competitive landscape of financial services

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Systems design, performance analysis and productivity, forecasting, inventory and cash management, waiting line analysis for capacity planning, staff scheduling, operational risk management, and pricing and revenue management are all important aspects of financial services. High volumes and substantial client heterogeneity (differences), frequent service contacts, and the use of technology in the service encounter are all key components of financial services operations. All of these things are changing dramatically as a result of new FinTech approaches: by creating a new basis for harmonizing investments across business partners and competitors; by making new products and services available that have a different operational basis, with reduced human involvement on purely transactional aspects, supported by machine intelligence where that is appropriate; and by making new products and services available that have a different operational basis, with diminished human involvement on purely transactional aspects, supported by machine intelligence where that is appropriate.

source:https://images.app.goo.gl/xh1CvsGZimhywibE9

Based on these insights, eight forces have been identified by the related literature to have the potential to shift the competitive landscape of financial services:

1. **Cost commoditization -** Operating costs are becoming less of a differentiator in the marketplace. Firms are experimenting with new technologies and collaborating with other organizations, including rivals and new entrants, to expedite the commoditization of their cost basis so that profits may be preserved, and more viable strategies can be pursued. In some cases, this may mean operating at a loss to promote churn in a competitor, and/or to grow the number of users on a platform quickly.

1. **Profit redistribution -** As the cost of bypassing intermediaries them to reach the final consumer decreases as a result of technological advancements, these intermediaries will need to discover new ways to financially offer value. Meanwhile, FinTech firms will have access to a growing pool of potential partners who can help them build and increase their client base. Regulators will have to figure out how changing fortunes are altering the value chain, with long-regulated

businesses giving way to new ones. Consumers' demands are also shifting in regard to Fintech firms’ profits, with requests of equity issuance and pre-IPO offerings.

1. **Experience ownership -** Many financial firms have traditionally distributed their own products. However, with the growth of platforms and other channels, savvy incumbents are preparing for situations when distribution is beyond their control. Recognizing that those who control the client experience have the upper hand, financial service providers are debating whether to pursue methods that need great size or concentration.

1. **Platforms rising -** Customers want more options in financial services, and they're increasingly expecting one-stop shopping. Institutions are trying to adapt, relying on digital platforms that allow them to offer services across various areas, frequently in collaboration with other suppliers.

1. **Data monetization -** Faced with an increasingly crucial future, businesses are beginning to gather data in flows rather than snapshots —for example, through location data obtained through consumer phones rather than transactions. Customers' databases are also being expanded by businesses.

1. **Bionic workforce -** On the front end, AI is emulating the devices that have come to dominate client interactions with many technological companies. Internally, employees are collaborating with AI to improve their efforts, drastically lowering the time and resources needed to finish major projects with well-defined, repetitive duties.

1. **Systemically important techs -** Major technological firms have showed little interest in providing financial services thus far. Financial organizations, on the other hand, are increasingly reliant on cloud-based infrastructure and use online data storage and processing tools.

The result is that financial services must strike a balance: on the one hand, they risk becoming too reliant on huge digital companies, while on the other, they risk falling behind their competitors. To prevent either scenario, financial institutions will need to figure out how to collaborate with technology businesses without losing sight of their core value proposition, as well as tolerate a loss of control over expenses and data.

1. **Financial regionalization -** Financial globalization looked inevitable a decade ago, when the movement of capital across borders was at its topmost. The tendency is now in the opposite direction, with financial services models tailored to local requirements. Divergent governmental agendas, technology capabilities, and customer conditions are complicating the story of expanding globalization, forcing industry participants to take alternative courses in different parts of the globe.

Disruption in Financial Intermediation

Objectives:

- Students will be able to describe the concept of disruption
- Students will be able to describe the role of intermediaries in financial transactions

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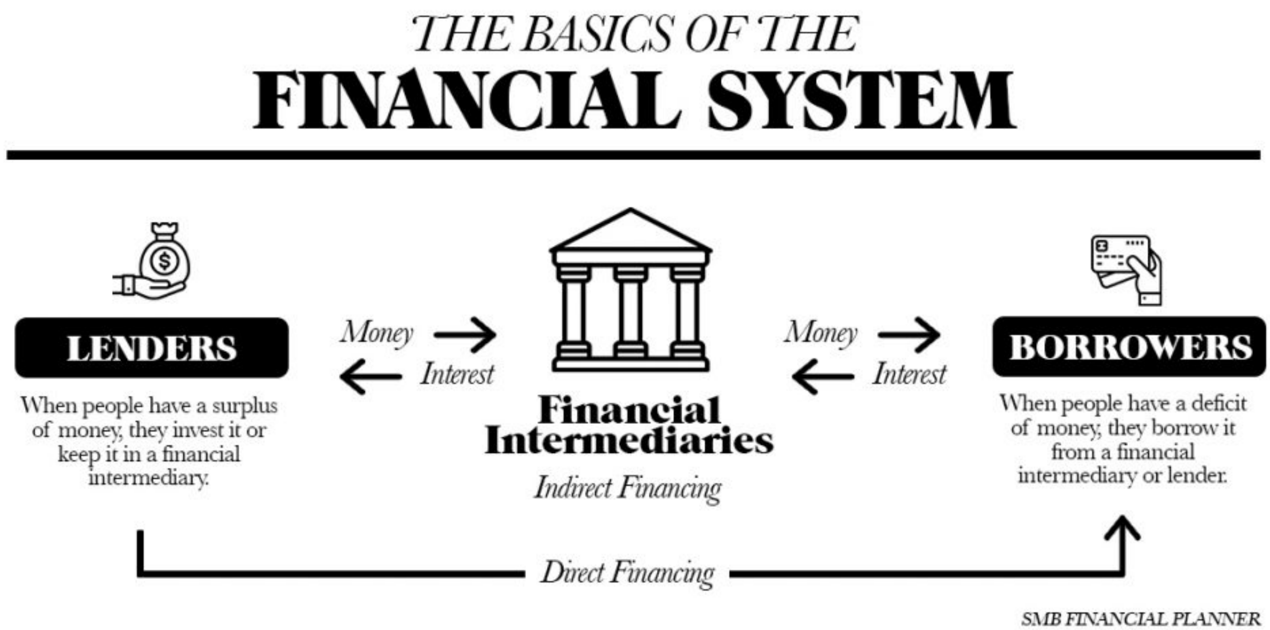
Disruption in Fintech refers to innovation that significantly changes the way that consumers, industries, or businesses operate or use financial services. A disruptive Fintech company sweeps away the systems or standards it replaces because it has attributes that provide superior service, access, quality, etc. Much of FinTech disruption occurs within the "legacy" financial service industry often seen as “ripe for disruption.”

Financial systems will undoubtedly need to adapt at a faster or slower pace, but at this point, it is unclear if some of the underlying rationales for the existence of financial intermediaries will be challenged by the FinTech innovations we are experiencing. The presence of financial intermediaries, like any other institution, is justified by the role they play in the process of resource allocation, particularly capital allocation.

Financial intermediates are experts in buying and selling financial contracts and securities at the same time. The presence of frictions in transaction technology, such as transaction costs, is a first reason for the existence of financial intermediaries. FinTech applications will challenge this logic by significantly decreasing transaction costs, if we think of financial intermediaries as other merchants (maybe brokers and dealers working on financial markets are a better illustration). Internet merchants and e-commerce provide a better comparison for determining the possible influence on this type of intermediation.

It's possible that new technology may at least partially replace the complete range of services presently provided by brokers and dealers. It's also feasible that new entrants will enhance competition in specific areas and perhaps supplant incumbents. Other financial intermediaries' operations, on the other hand, are often more complicated.



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For starters, financial institutions such as banks and insurance firms often deal with financial transactions that cannot be readily resold, such as loans and deposits. As a result, these intermediaries must keep these contracts on their books until they expire. Recent applications of securitization and structured products, on the other hand, have resulted in an originate and distribute business model, in which illiquid assets may be moved off of financial intermediaries' balance sheets. Secondly, the features of borrowers' contracts differ significantly from those of depositors' contracts. As a result, financial intermediaries vary from ordinary shops in that they also alter financial contracts in terms of denomination, quality, and maturity.

The simplest approach to justify financial intermediaries' existence is to stress the difference between their inputs and outputs, and to consider their primary activity as financial securities transformation. As a result, financial intermediaries may be thought of as groups of economic agents who take advantage of transaction technology's economies of size and breadth.

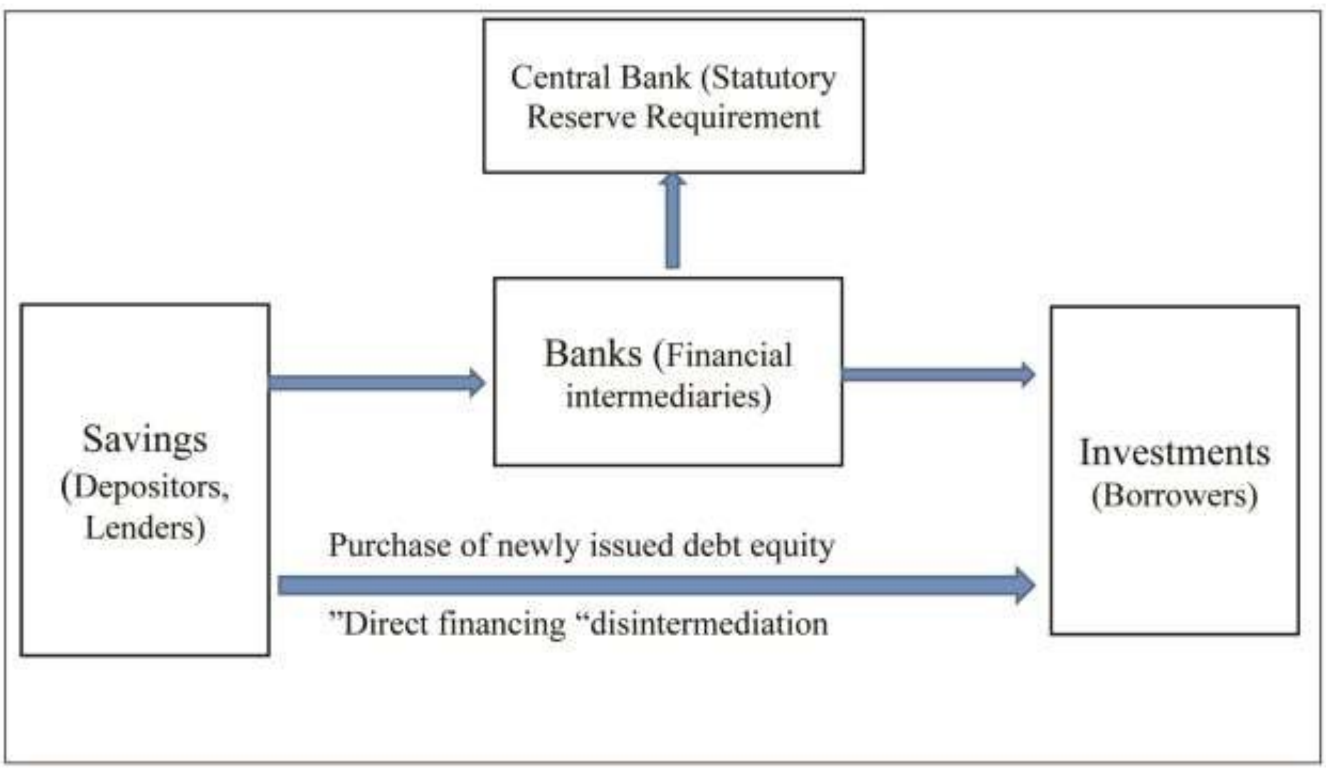
Disintermediation of Capital and Payments

Objectives:

- Students will be able to define disintermediation
- Students will be able to discuss the benefits of disintermediation

---

Disintermediation in Fintech refers to innovation that significantly removes or reduces intermediaries in providing financial services. This often leads to competitive advantages, increased profits and superior user experience by "cutting out the middle-man."



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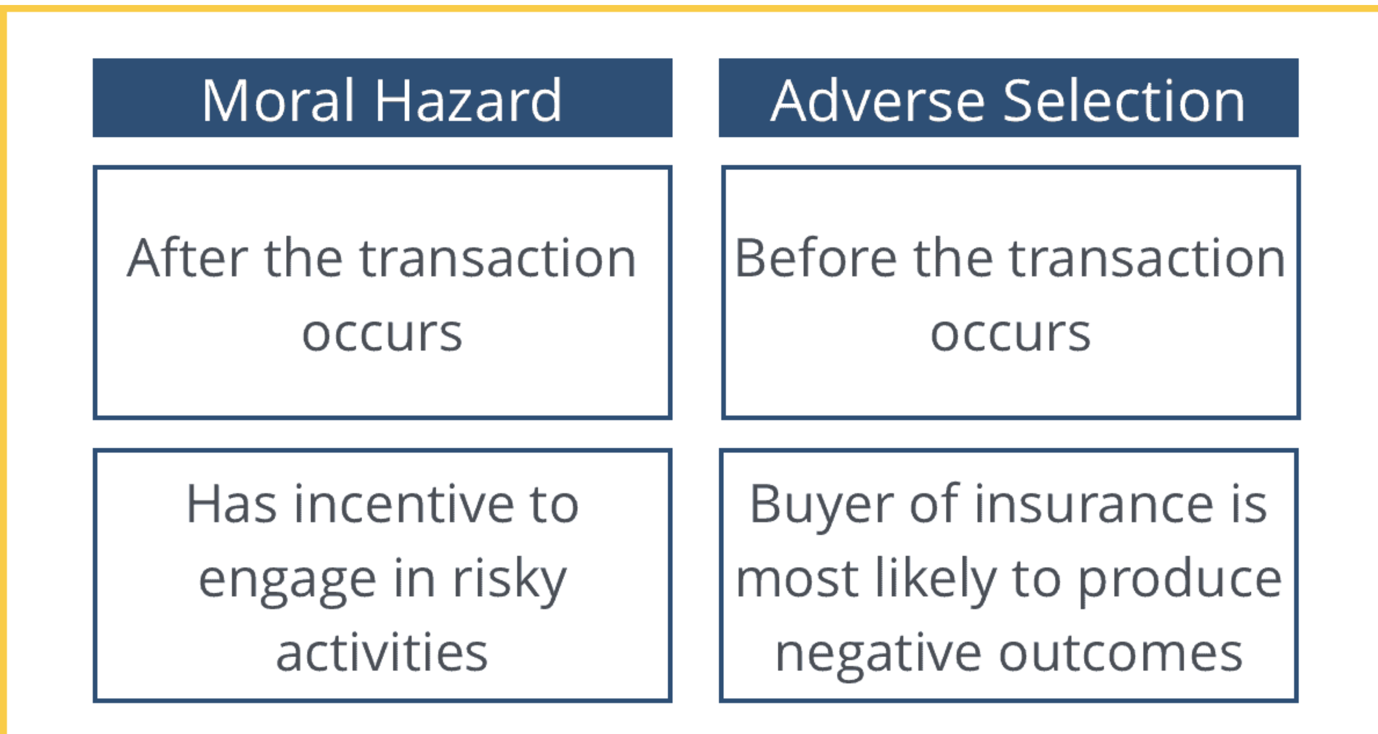
The existence of transaction costs may be the source of these economies of size and scope. Banks, for example, begin by managing deposits in close proximity to the more basic process of money changing. Old age bankers may readily provide the service to merchants and traders since they already have a need for safeguarding facilities for their own money; that is, there are economies of scale between money-changing and safekeeping deposits. Because of constant transaction costs or, more broadly, growing returns in transaction technologies, economies of scale may exist. While transaction costs associated with physical technology may have played a part in the formation of financial intermediaries in the past, advances in digital technologies may call into question this justification for their existence. However, there are other types of transaction costs, maybe more basic, that are unlikely to be lowered to the point of disrupting financial intermediation by FinTech innovation.

Specific types of transaction costs, such as adverse selection, moral hazard, and costly state verification, may arise in finance as a result of market inefficiencies caused by informational asymmetries. Financial intermediaries can offset these costs, at least in part, by taking advantage of economies of size and scope in information sharing, monitoring, and offering liquidity insurance.

Adverse selection, or instances in which borrowers are better informed than investors about the quality of the project they are trying to fund, can lead to lending-borrowing economies of scale. Borrowers can mitigate the problem of adverse selection by self-financing a portion of the project. If borrowers are risk averse, however, this signaling is expensive since they must keep a significant portion of the risk. In this instance, a financial intermediary in the shape of a coalition of borrowers is able to secure better financing terms than individual borrowers by taking advantage of economies of scale in information sharing: the signaling cost rises more slowly than the coalition's size. Still, in the case of adverse selection, coalitions of diverse borrowers can enhance market outcomes by allowing cross-subsidization within the coalition and taking use of economies of scope in screening operations.

Some of the FinTech advances we've seen so far may actually support, rather than contradict, this perspective of financial intermediation by lowering the costs of communication, information exchange, and data verification in terms of both time and money. At the same time, it's difficult to see how the new technologies mentioned in the preceding section might be used to solve the adverse selection problem on their own. When considering other basic rationales for financial intermediation, a similar conclusion may be drawn.

Moral hazard and expensive ex post verification, for example, may be an issue when borrowers are opportunistic. Monitoring may be an option in this scenario. Monitoring operations generally entail economies of scale, implying that such tasks are more efficient when carried out by specialized companies. As a result, individual investors would prefer to entrust monitoring to such a specialist organization.



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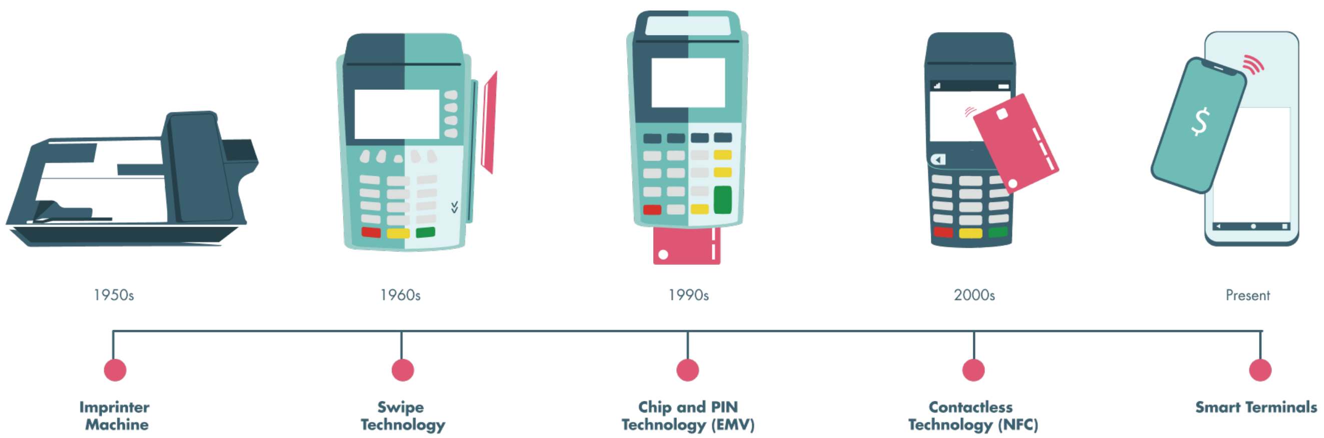
The current worry is that if monitors are self-interested, they must be provided incentives to do their duties appropriately. Financial intermediaries, according to several interpretations, give answers to this motivation dilemma. One argument is that the ideal arrangement will resemble a bank deposit contract, and that by diversifying the loan portfolio, the financial intermediary will be able to reduce the cost of monitoring as much as feasible, approaching riskless deposits. Another point of view is that the ability to remove demand deposits is an acceptable tool for punishing bankers. There are also informational economies of scope between monitoring and lending activities, which explains the need of bank capital. Finally, in an economy where agents are individually susceptible to separate liquidity shocks, deposit contracts issued by a financial intermediary have the potential to exceed market allocation. FinTech advancements may make it easier for businesses, particularly small businesses, and consumers to fund themselves directly, putting more pressure on financial intermediaries.

It may also be used to bring in agents who were previously barred from financial circles. This might be attributed to lower transmission and data processing costs, as well as better record keeping. Big data and the internet of things aid in the provision of tailored and differentiated financial products, enhancing the attractiveness and effectiveness of offerings. However, opportunistic behavior factors that prohibit businesses with insufficient assets or reputation from obtaining direct financing will continue to exist, and intermediate finance appears to be the only viable option.

Financial intermediation is expected to coexist alongside direct finance in the future, notwithstanding FinTech advancements. The majority of FinTech innovations to date have been in the areas of payment systems, electronic money and wallets, and peer-to-peer lending. The massive reduction in transmission costs, the massive networks of social network users (where users are more fans than customers), and the image generated by some IT businesses place them in a strategic position to provide these types of financial solutions.



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Money transfers via Facebook Messenger, electronic payments via Amazon Pay, and Alibaba's electronic wallet are all examples. Clearly, these services compete directly with similar services formerly offered by banks and other traditional financial institutions. However, the latter have the benefit of being perceived as safer and more trustworthy – due in part to massive expenditures in cybersecurity–, whilst the former must continue to emphasize this problem, particularly because they would be a lucrative target for hackers. FinTech advancements are also being used by banks to lower the cost of money transfers. For example, Barclays utilizes Bitcoin subsidiaries to transfer money between countries, significantly decreasing transaction time and cost. Financial resources and information are required for other financial intermediation operations such as deposit and lending.

Both conventional banks and internet firms, such as Google, have both sorts of resources; one group may have different forms of perhaps complimentary information than the other. Google now offers payment services through Google Wallet and Android Pay, but it also owns bank licenses in a number of countries. If Google begins banking operations, it will significantly boost competition for traditional banking. Certainly, the way information is received, processed, and utilized to make financial decisions would alter, as would the procedures for mitigating the asymmetric information issues that necessitate financial intermediation, as well as the channels through which financial goods are commercialized. The rationales for fundamental banking operations, on the other hand, do not appear to be challenged by this change in banking practices and the use of technology and information.

Democratization in Financial Services

Objective:

- Students will be able to define democratization as it applies to FinTech

---

Democratization in FinTech refers to significantly increasing access to financial services making them "open to all." This is often by providing new financial services that weren't traditionally available to disenfranchised, unqualified and underserved consumers, business and industries.

source:https://images.app.goo.gl/Kk32DtdZdvwMYz3L9

New technologies have spawned the so-called platform economy, which has permitted the most efficient contact between customers and service providers, including financial ones, in recent years. Technological convergence, the result of the coexistence of various technologies as well as the development of the Internet of Information, has now evolved into the Internet of Value (with distributed ledger technology - DLT) in a union of innovative collaborative economy systems that is arming individuals with tools that are posing a threat to the status quo.

The FinTech boom of the last decade has ushered in the most significant shift in the financial industry, in terms of business models, distribution channels, and financial service offering. For various reasons, technology is driving an accelerated process of financial democratization by increasing competition in the sector, thanks to the collapse of many conventional entry barriers in banking, which are now available to FinTechs and bigtechs (big technology businesses).

Banking is being heavily digitized as a result of technology and its disruptive use in the financial industry. This benefits consumer of financial services, who can profit from collaborative economy platforms in some situations, such as crowdfunding in its various forms. In other situations, it's for improved access to financial data and the ability to utilize comparators. It should be emphasized that the new rule mandating banks to expose their data to third parties approved by consumers is also a kind of deregulation (as is the case with the PSD2 law).

In the field of financial analysis and planning, several technologies are particularly beneficial. In-depth study of the behavior of users of financial services is feasible because to the ability to utilize information (e.g., big data). These technologies handle massive amounts of data, which may be easily exploited by new rivals, such as FinTech disruptors and major technology firms that specialize in big data collection. Furthermore, many of the tasks of conventional bank intermediation must be reassessed as new players enter the FinTech sector, as well as the well-known presence of big technology corporations with financial operations (conceptualized as techfin).

The empowerment that technology provides individuals necessitates a shift in the relationship between financial institutions and their customers. Parallel to the digital revolution, the banking system has recovered from the profound economic and financial crisis. There has been a Darwinian quasi-extinction in some parts of the financial industry, favoring the creation of new, more suited and nimble species, such as FinTech businesses, or the discovery of new functions by extremely powerful species, such as major technology corporations or bigtechs.

In addition, there has been a process of sociocultural change in the new digital society with the inclusion of new generations: the already active millennials; and the more recent centennials, who have a different orientation in their means of relationship for the purposes of consumption, leisure, communication, as well as savings and investment.

In many financial operations, the notion that dramatic alterations necessitate restarting or raising procedures in their entirety begins to make sense. As a result, the early but growing use of blockchain technology will reshape financial intermediation and eliminate well-established actors like clearing houses, settlement systems, centralized order and transaction management, transfer systems, and even the currency's own configuration and future digitization via cryptoactives. Due to the pace of change and its global scope, it is an unparalleled shift; one that appears to be assimilated to the notion of deconstruction.

Financial service users will be more volatile and less loyal; therefore, no company will be willing to fall behind in terms of change adaption. These clients are increasingly demanding high-quality services, operational agility, and a new economic culture that includes distinct purchasing patterns and technological behavior. All of this will need striking an appropriate balance between conventional and new financial procedures, as well as the establishment of a transition system that will keep customers on track and add new clients to ensure the digital transformation process is viable.

In short, the financial sector is undergoing multiple and rapid developments, all of which are serving as catalysts for further financial democratization. To summarize--Disruption, disintermediation and democratization come together to form a trifecta and are core principles for fintech innovation today.

Python Data Types

Objectives:

- Understand common data types we'll encounter as we learn Python
- Review the syntax for common data types
- Understand basic type casting

Name	Type	Description
Integers	int	Whole numbers, such as: 3 300 200
Floating Point	float	Numbers with a decimal point: 2.3 4.6 100.0
Strings	str	Ordered sequence of characters: 'hello" 'Sammy' "2000" "Ally"
Lists	list	Ordered sequence of objects: [10, "hello", 200.3]
Dictionaries	dict	Unordered Key:Value pairs: ("mykey" : "value" , "name" , : "Frankie")
Tuples	tup	Ordered immutable sequence of objects: (10,"hello",200.3)
Sets	set	Unordered collection of unique objects: {"a", "b"}
Booleans	bool	Logical value indicating **True** or **False**

A **Data Type** refers to how a given value is classified. Here's a list of the data types that you will likely be using in Data Science and Data Governance applications:

Primitive data types

These are the basic building blocks of a language. Most languages have these in common:

- **Boolean Values** - Assesses the truth value of something. It has only two values: *True* and *False* (note the uppercase T and F)

```
is_hungry = True
has_freckles = False
```

- **Numbers** - Integers (whole numbers), floating point numbers (commonly known as decimal numbers), and complex numbers

```
age = 35
weight = 160.57
```

- **Strings** - literal text

```
name = "Joe Blue"
```

Composite types

These are collections composed of the above primitive types.

- **Tuples** - A type of data that is **immutable** (can't be modified after its creation) and can hold a group of values. Tuples can contain mixed data types.

```
dog = ('Bruce', 'cocker spaniel', 19, False)
print(dog[0])
dog[1] = 'dachshund'
```

- **Lists** - A type of data that is mutable and can hold a group of values.

Usually meant to store a collection of related data.

```
empty_list = []
ninjas = ['Rozen', 'KB', 'Oliver']
print(ninjas[2])
ninjas[0] = 'Francis'
ninjas.append('Michael')
print(ninjas)
ninjas.pop()
print(ninjas)
ninjas.pop(1)
print(ninjas)
```

- **Dictionaries** - A group of key-value pairs. Dictionary elements are indexed by unique keys which are used to access values. When you're ready, you can find more built-in dictionary methods here.

```
empty_dict = {}
new_person = {'name': 'John', 'age': 38, 'weight': 160.2,
'has_glasses': False}
new_person['name'] = 'Jack'
new_person['hobbies'] = ['climbing', 'coding']
print(new_person)

w = new_person.pop('weight')
print(w)
print(new_person)
```

Common Functions

If we're ever unsure of a value or variable's data type, we can use the `type` function to find out. For example:

```
print(type(2.63))
print(type(new_person))
```

For data types that have a length attribute (eg. lists, dictionaries, tuples, strings), we can use the `len` function to get the length:

```
print(len(new_person))
print(len('Coding Dojo'))
```

Type Casting or Explicit Type Conversion

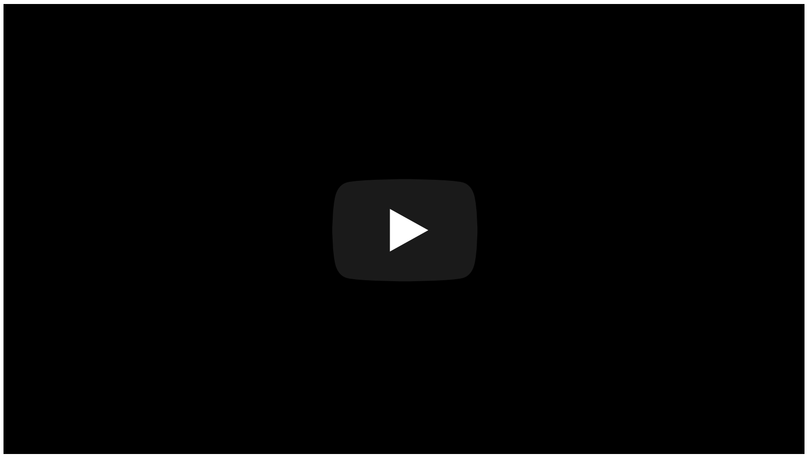
We may find ourselves wanting to change a value's data type from one type to another. For example, in the Hello World assignment, trying to print a string *plus* a number resulted in a TypeError. Python doesn't know how to add a string and a number, but it can add two strings together, so if we can **cast** the number *as a string*, then we will be able to "add" the two values together, like so:

```
print("Hello" + 42)
print("Hello" + str(42))
```

Another example may be receiving a string input from a user that we want to treat as a number:

```
total = 35
user_val = "26"
total = total + user_val
total = total + int(user_val)
```

Python Tutorial for Beginners: Understand Python Data Types in 10 minutes (9 minutes)



Working with Strings in Python

Objectives:

- Recognize various methods for combining variables with literal strings
- Be aware of commonly used string methods and where to go for more information

---

Method	Description
strip()	Removes any whitespace form the beginning or the end
lower()	Returns a string in lower case characters.
upper()	Returns a string in uppercase characters.
replace()	Replaces a string with another string.
split()	Splits the string into sub strings.
capitalize()	Capitalizes the first character in the string.
count()	Returns no. of occurrences in the string.
index()	Returns the index of the character.
find()	Gives the index value of the string specified.
isalpha()	Returns true if the string has only alphabets.
islanum()	Returns true if the string has both alphabets and numbers.
isdigit()	Returns true if the string has only numbers.
islower()	Returns true if the string has only lower case characters.
isupper()	Returns true if the string has only upper case characters.

String Literals

Strings are any sequence of characters (letters, numerals, special characters, ~($/}\#, etc.) enclosed in single or double quotes. We can display a string like this:

```
print("this is a sample string")
```

Concatenating Strings and Variables with the print function

There are multiple ways that we can print a string containing data from variables.

The first way to print a string containing data from variables is by adding a comma after the string, followed by the variable. Note that the comma is *outside* the closing quotation mark of the string. The `print()` function inserts a space between elements separated by a comma.

```
name = "Zen"
print("My name is", name)
```

The second is by concatenating the contents into a new string, with the help of **+**.

```
name = "Zen"
print("My name is " + name)
```

There is one other difference between concatenating using a plus versus using a comma, can you find out what it is?

Hint: try concatenating a string with an integer using each method.

String Interpolation

We can also inject variables into our strings, which is known as **string interpolation**. There are a few different ways this can be done.

F-Strings (Literal String Interpolation)

Python 3.6 introduced f-strings for string interpolation. To construct an f-string, place an `f` right before the opening quotation. Then within the string, place any variables within curly brackets.

```
first_name = "Zen"
last_name = "Coder"
age = 27
print(f"My name is {first_name} {last_name} and I am {age}
years old.")
```

string.format()

Prior to f-strings, string interpolation was accomplished with the `.format()` method. If you're searching online, you will likely find code snippets using this method. To use it, type out the full string, replacing any words that will get their values from variables with `{}`. Then call the `format` method on the string, passing in arguments in the order in which they should fill the {} placeholders.

Here's an example:

```
first_name = "Zen"
last_name = "Coder"
age = 27
print("My name is {} {} and I am {} years
old.".format(first_name, last_name, age))

print("My name is {} {} and I am {} years old.".format(age,
first_name, last_name))
```

The two example print statements are provided to demonstrate that the format method reads the string from left to right, replacing the {} with the value of the arguments provided, in order. This means there should be the same number of sets of {} as there are arguments passed into the function.

%-formatting

There is an even older method of string interpolation that you may come across when troubleshooting or researching, so you should know about it. Rather than curly braces, the `%` symbol is used to indicate a placeholder, a `%s` for a string and `%d` for a number. After the string, a single `%` separates the string to be interpolated from the values to be inserted into the string, like so:

```
hw = "Hello %s" % "world"
py = "I love Python %d" % 3
print(hw, py)

name = "Zen"
age = 27
print("My name is %s and I'm %d" % (name, age))
```

Built-In String Methods

We've seen the format method, but there are several more methods that we can run on a string. Here's how to use them:

```
x = "hello world"
print(x.title())

"Hello World"
```

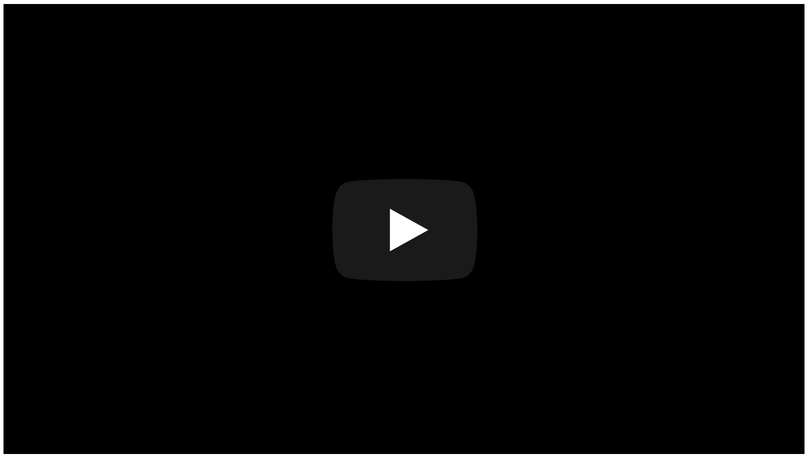
The following is a list of commonly used string methods:

Note everywhere you see the word `string`, you need to replace this with an actual instance of a string. For example `"hello world".upper()` will return a transformed copy of the "hello world" string to look like "HELLO WORLD".

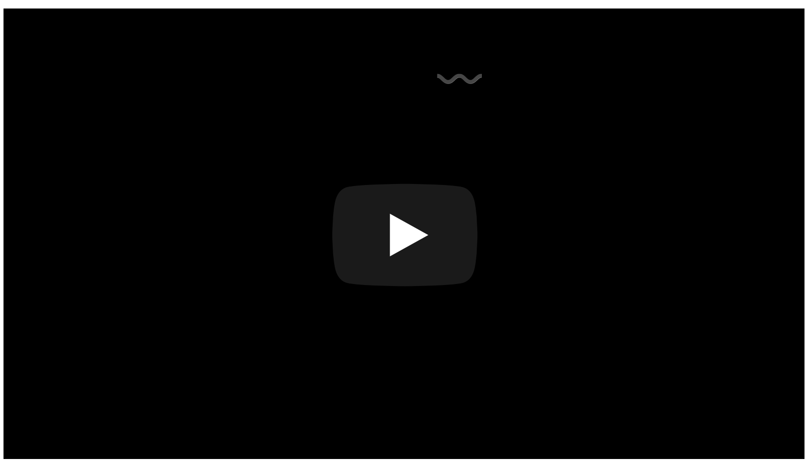
- `string.upper()`: returns a copy of the string with all the characters in uppercase. Example: `print("hello world".upper())`
- `string.lower()`: returns a copy of the string with all the characters in lowercase.
- `string.count(substring)`: returns number of occurrences of substring in string.
- `string.split(char)`: returns a list of values where string is split at the given character. Without a parameter the default split is at every space.
- `string.find(substring)`: returns the index of the start of the first occurrence of substring within string.
- `string.isalnum()`: returns a boolean depending on whether the string's length is > 0 and all characters are alphanumeric (letters and numbers only). Strings that include spaces and punctuation will return False for this method. Similar methods include `.isalpha()`, `.isdigit()`, `.islower()`, `.isupper()`, and so on. All return booleans.
- `string.join(list)`: returns a string that is all strings within our set (in this case a list) concatenated
- `string.endswith(substring)`: returns a boolean based upon whether the last characters of string match substring.

It's important to know that we have only introduced you to the basics of what we can do with strings. There is a lot more you can do with string interpolation, and every data type has numerous built-in methods. The Python documentation is the best place to look for more information. For example, "String Methods" can be found in the Python docs. Get a general idea of the tools we have available to us and try experimenting with them in the shell to see what they can do, but don't spend time trying to memorize them, though. You can always look up whatever you need to use.

Quick Intro to F-Strings in Python for String Formatting: (4 minutes)



Python string methods 〰️: (5 minutes)



Working with Loops in Python

Objectives:

- Understand how to loop through a range of numbers
- Understand how to loop through a list
- Understand how to loop through a dictionary
- Understand how to use a while loop
- Understand break and continue statements within loops

In [17]:
```
i = 0
while i < 5:
    print('Iteration number '+str(i)+'!' )
    i += 1
print('i = ' + str(i))
```

```
Iteration number 0!
Iteration number 1!
Iteration number 2!
Iteration number 3!
Iteration number 4!
i = 5
```

For Loops with Range

If we want to iterate through numbers, we can use Python's `for` loop and `range()` function. Let's learn how this works by comparing how for loops work in JavaScript:

JavaScript

```javascript
for (var x = 0; x < 10; x += 1) {
    // what to do in each iteration
}
```

Python

```python
for x in range(0, 10, 1):
    # what to do in each iteration
```

for - indicates the start of a for loop
x - the iterator
0 - the value to start iterating with
10 - the value to stop iterating at (exclusive, i.e. in this case, if the value of x is 10, the loop is over)
1 - the value by which the iterator changes for each iteration
{ or : - indicates the following code is related to this loop

Notice that the `range()` function takes 3 arguments. The first value is where the loop should begin, the second value is where the loop should end (exclusive), and the third value is how to increment the iterator.

The range function actually comes with a few shortcuts. If we know the increment is going to be plus one, we can actually just ignore the third argument. Furthermore, if we know the increment is going to be positive one *and* the loop starts at 0, we can also leave off the first argument. In other words, each of the following will result in exactly the same loop:

```python
for x in range(0, 10, 1):
for x in range(0, 10):
for x in range(10):
```

Note that if you need to specify an increment other than +1, all three arguments are required.

```python
for x in range(0, 10, 2):
    print(x)

for x in range(5, 1, -3):
    print(x)
```

For Loops through Lists

If we want to iterate through a list, we could use the range function and send in the length of the list as the stopping value, but if we are not interested in the index values and want to just see the values of each item in the list in order, we can actually loop to get the values of the list directly!

```
my_list = ["abc", 123, "xyz"]
for i in range(0, len(my_list)):
    print(i, my_list[i])
```

```
for v in my_list:
    print(v)
```

For Loops through Dictionaries (Optional)

Dictionaries are also iterable. When we iterate through a dictionary, the iterator is each of the *keys* of the dictionary.

```
my_dict = { "name": "Noelle", "language": "Python" }
for k in my_dict:
    print(k)
```

That means if we want the *values* of our dictionary, we might do something like this:

```
my_dict = { "name": "Noelle", "language": "Python" }
for k in my_dict:
    print(my_dict[k])
```

Dictionaries also have a few additional methods that allow us to iterate through them and have the keys and/or values as the iterator. Test these out to get a better understanding:

```
for key in capitals.keys():
    print(key)

for val in capitals.values():
    print(val)

for key, val in capitals.items():
    print(key, " = ", val)
```

While Loops

While loops are another way of looping *while* a certain condition is true.

Remember this **for loop**?

```
for count in range(0,5):
    print("looping - ", count)
```

We can rewrite it as a **while loop**:

```
count = 0
while count < 5:
    print("looping - ", count)
    count += 1
```

The basic syntax for a **while loop** looks like this:

```
while <expression>:
```

Else

There are certain conditions that we give for every loop that we have, but what if the condition was not met and we still would like to do something if that happens? We can then use an **else** statement with our while loop. Yes, that is right, **else** in a **loop**.

```
y = 3
while y > 0:
    print(y)
    y = y - 1
else:
    print("Final else statement")
```

The output would be:

Note that this **else** code section is only executed if the **while loop** runs normally and it's **conditional** is false (whether we never entered the **while loop**, or we did but eventually the conditional changed from true to false). If instead our **while loop** is exited prematurely because of a *break* or *return* statement, then the **else** code section will never be executed.

Loop Control

We were introduced to control flow in the previous tabs with if and else statements. *Loops*, *breaks*, and *continues* are all a part of control flow as well. Control flow is the cornerstone of most programming languages.

When you want finer control over your loops, use the following statements to do so.

Break

The **break** statement exits the current loop prematurely, resuming execution at the first post-loop statement. The *break* statement can be used in both **while** and **for** loops. The most common use for the *break* is when some external condition is triggered, requiring a hasty exit from a loop. When loops are nested, a *break* will only exit from the innermost loop.

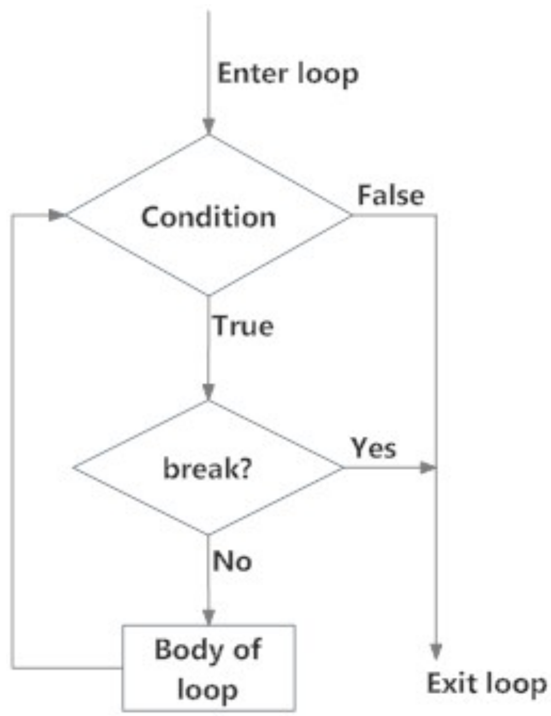


Fig: flowchart of break

```
for val in "string":
    if val == "i":
        break
        print(val)
```

Notice that when the loop got to the letter "i", we stopped looping.

Continue

The **continue** statement immediately returns control to the beginning of the loop. In other words, the *continue* statement rejects, or skips, all the remaining statements in the current iteration of the loop, and continues normal execution at the top of the loop. The *continue* statement is very useful when you want to skip specific iteration(s), but still keep looping to the end.

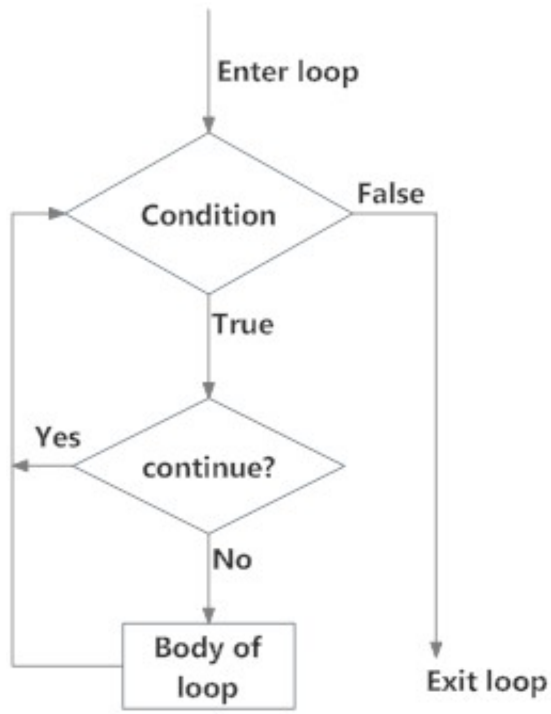
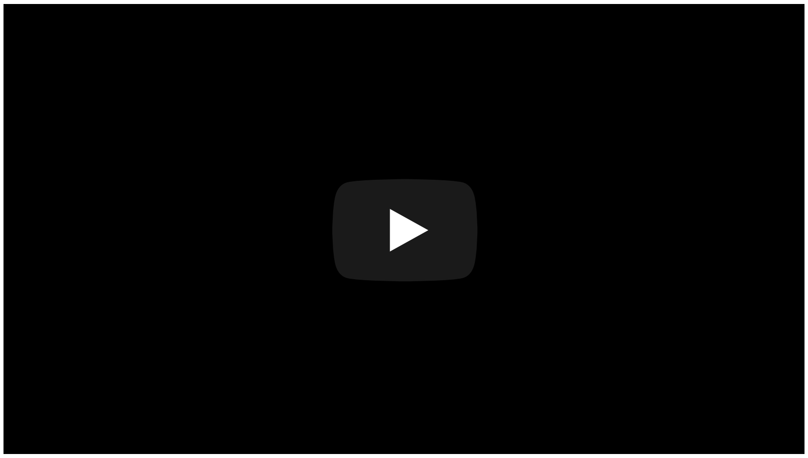


Fig: flowchart of continue

```
for val in "string":
    if val == "i":
        continue
    print(val)
```

```
y = 3
while y > 0:
    print(y)
    y = y - 1
    if y == 0:
        break
else:
    print("Final else statement")
```

While Loops and For Loops in Python | Learning Python for Beginners | Code with Kylie #6: (11 minutes)



Working with Conditional Statements in Python

Objectives:

- Know the syntax of conditional statements
- Understand when to use a conditional statement

Conditional statements allow us to run certain lines of code depending on whether certain conditi keywords for conditional statements are `if`, `elif`, and `else`. Here are some examples:

```
x = 12
if x > 50:
    print("bigger than 50")
else:
    print("smaller than 50")
# because x is not greater than 50, the second print statement is the only one that w

x = 55
if x > 10:
    print("bigger than 10")
elif x > 50:
    print("bigger than 50")
else:
    print("smaller than 10")
# even though x is greater than 10 and 50, the first true statement is the only one t
ill only see 'bigger than 10'

if x < 10:
    print("smaller than 10")
# nothing happens, because the statement is false
```

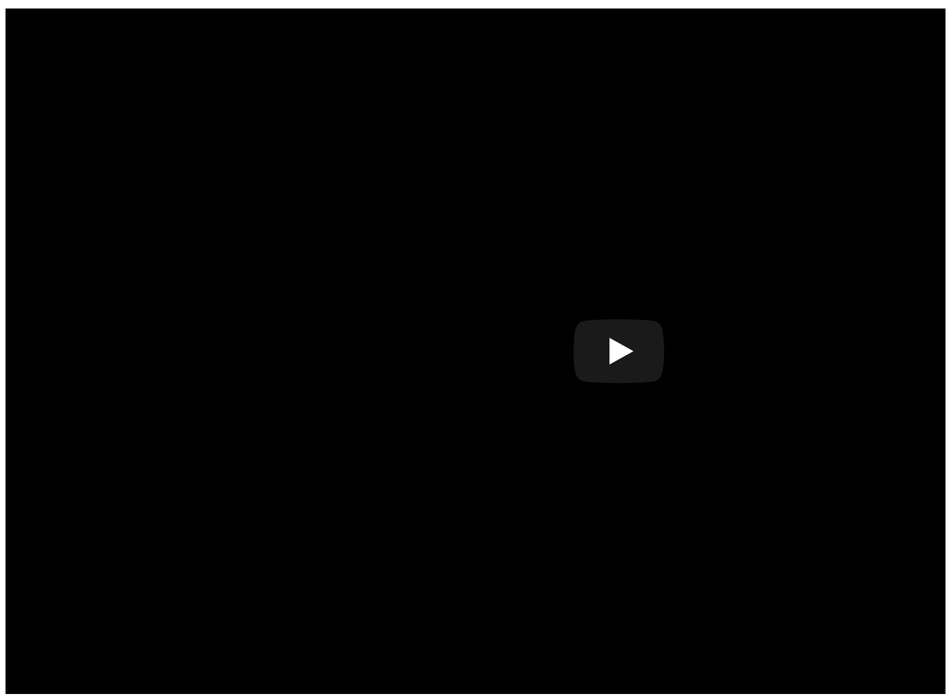
Comparison and Logic Operators

Here is a table of the comparison operators you can use in your Python programs.

Operator	Description	
==	Checks if the value of two operands are equal	1 == 2 => False 1 == 1 => True

!=	Checks if the value of two operands are not equal	1 != 2 => True 1 != 1 => False
>	Checks if the value of left operand is greater than the value of right operand	1 > 2 => False 2 > 1 => True
<	Checks if the value of left operand is less than the value of right operand	1 < 2 => True 2 < 1 => False
>=	Checks if the value of left operand is greater than or equal to the value of right operand	1 >= 2 => False 2 >= 2 => True
<=	Checks if the value of left operand is less than or equal to the value of right operand	1 <= 2 => True 2 <= 2 => True
and	Checks that each expression on the left and right are both True	(1 <= 2) and (2 (1 <= 2) and (2 (1 >= 2) and (2
or	Checks if either the expression on the left or right is True	(1 <= 2) or (2 > (1 <= 2) or (2 < (1 >= 2) or (2 >
not	Reverses the true-false value of the operand	not True => Fal not False => Tr not 1 >= 2 => T not 1 <= 2 => F not (1 <= 2 and not 1 <= 2 and

Python Programming #8 - Conditional Statements: (8 minutes)



FinTech 3.5

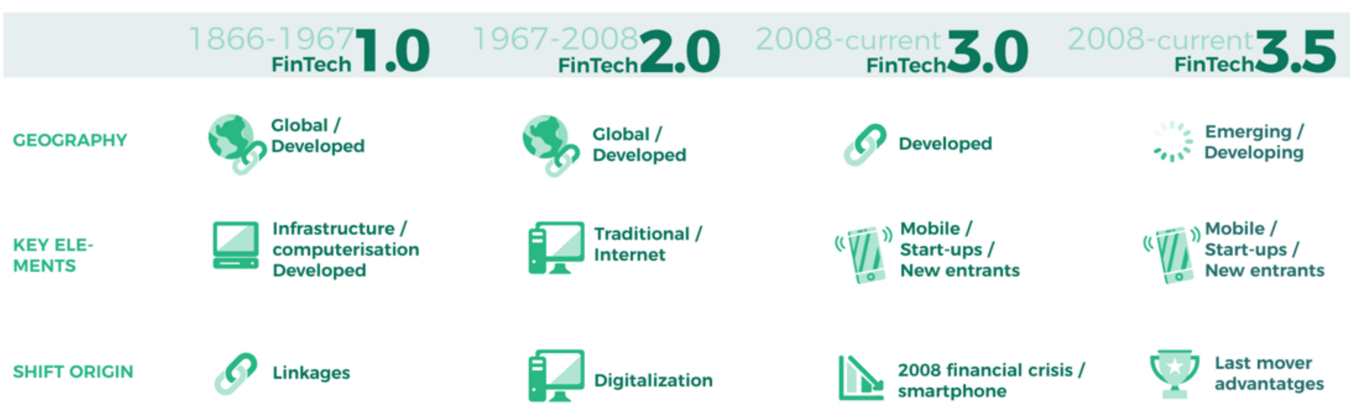
Objectives:

- Students will be able to describe the key attributes of FinTech 3.5
- Students will be able to discuss the the role of the mobile phone in the emergence of FinTech in the developing world

---

Because of the way mobile phones have transformed consumer behavior and how people use the internet. Recent FinTech advances in Asia and Africa have been mostly driven by intentional government policy choices in the pursuit of economic development. FinTech 3.5 is how we describe the current age in these areas.&

For over one billion unbanked people in these countries, “reputational” elements that foster the impression that only banks can provide banking services are unimportant, because banking may be supplied by any entity, whether licensed or not: banking is essential, banks are not.



We tend to think of banks and FinTech firms as antagonistic forces battling for market share as technology becomes increasingly essential in the banking industry. The truth is that both sides require each other just as much as they require competition.

FinTech firms, on the one hand, have received bank investment and frequently rely on banking, insurance, and back-office partners to offer their main goods. Banks, on the other hand, have bought or invested in FinTech firms to improve their existing operations and products by using new technologies and methods of thinking.

APAC

Objectives:

- Students will be able to describe the unique factors driving the rapid expansion of FinTech in APAC
- Students will be able to discuss the underlying rational of FinTech 3.5

The expansion of the APAC FinTech market is due to a number of factors, including APAC traditional banks' slower IT spending, public distrust of the state-owned banking system (due to corruption and mismanagement), narrowly defined branch network delivery, and very high internet and smartphone penetration rates. To understand Asian FinTech trends, one needs go beyond stated investment statistics. According to major point data providers, just almost one billion dollars out of the nineteen billion in new FinTech investment in 2019 was invested in the Asia-Pacific (APAC) area.

FinTech accelerators for start-ups have opened in Hong Kong and Singapore, as well as Brisbane, Sydney, and Melbourne, with more on the way in Korea. For example, Stone & Chalk, a specialized co-working facility in Australia, got over 350 applications for 150 spots. Korea is planning to extend Level 39 (London's well-known FinTech co-working facility). The majority of Asian regulators have also begun to develop a FinTech policy. This tendency is aided by China's market reforms, which have shifted the country from a mono-banking to a highly commercialized financial sector. Since 2009, China has seen the emergence of over 3000 peer-to-peer lending platforms, and we should not anticipate this trend to cease, especially after the government’s decisions through the internet Finance Guidelines.

FinTech 3.5 has a strong underlying rationale, which includes the following characteristics:

1. young digitally savvy populations with mobile devices,
2. a rapidly growing middle class,
3. inefficient financial markets creating openings for informal options,
4. a lack of physical banking infrastructure,
5. a behavioral predisposition in favor of convexity. In addition, there are a huge number of engineering and technology graduates, notably in India and China,
6. untapped market opportunities (1.2 billion people without bank accounts),
7. less stringent data protection and competition.

The combination between a vibrant private sector eager to expand into financial services and a public sector encouraging market reform and diversification to boost economic development is further reinforcing these tendencies. All of this implies that FinTech development in Asia is a result of a combination of entrepreneurial and regulatory factors, rather than a new post-crisis paradigm.

The possibility for profit must be weighed against the market's and region's unique obstacles. In comparison to established Western markets, APAC investors and networks are less sophisticated. In market action, there exist significant knowledge asymmetries. Second, finance is difficult to get through due to the high hurdles to entry into retail banking (e.g., regulatory capital requirements, ownership structures, and market restrictions). Furthermore, when businesses grow, the fragmented regulatory environment puts B2C FinTech firms at a disadvantage relative to B2B firms, particularly those that sell to banks, because they partially shift the compliance responsibility to the client.

While the APAC area offers enormous potential, it also faces unique problems. Investors, networks, and financial engineering are less sophisticated in APAC than in the EU and the US, resulting in information gaps and restrictions for FinTech firms. With significant hurdles to entry in retail banking, financing is also difficult to come by. Furthermore, when companies grow in size, the fragmented regulatory environment disadvantages business-to-consumer FinTech firms compared to business-to-business (B2B) firms, as B2B firms partially pass compliance cost to their clients. When compared to the harmonized European market, the fragmentation in APAC, which consists of 24 nations, is clearly visible.

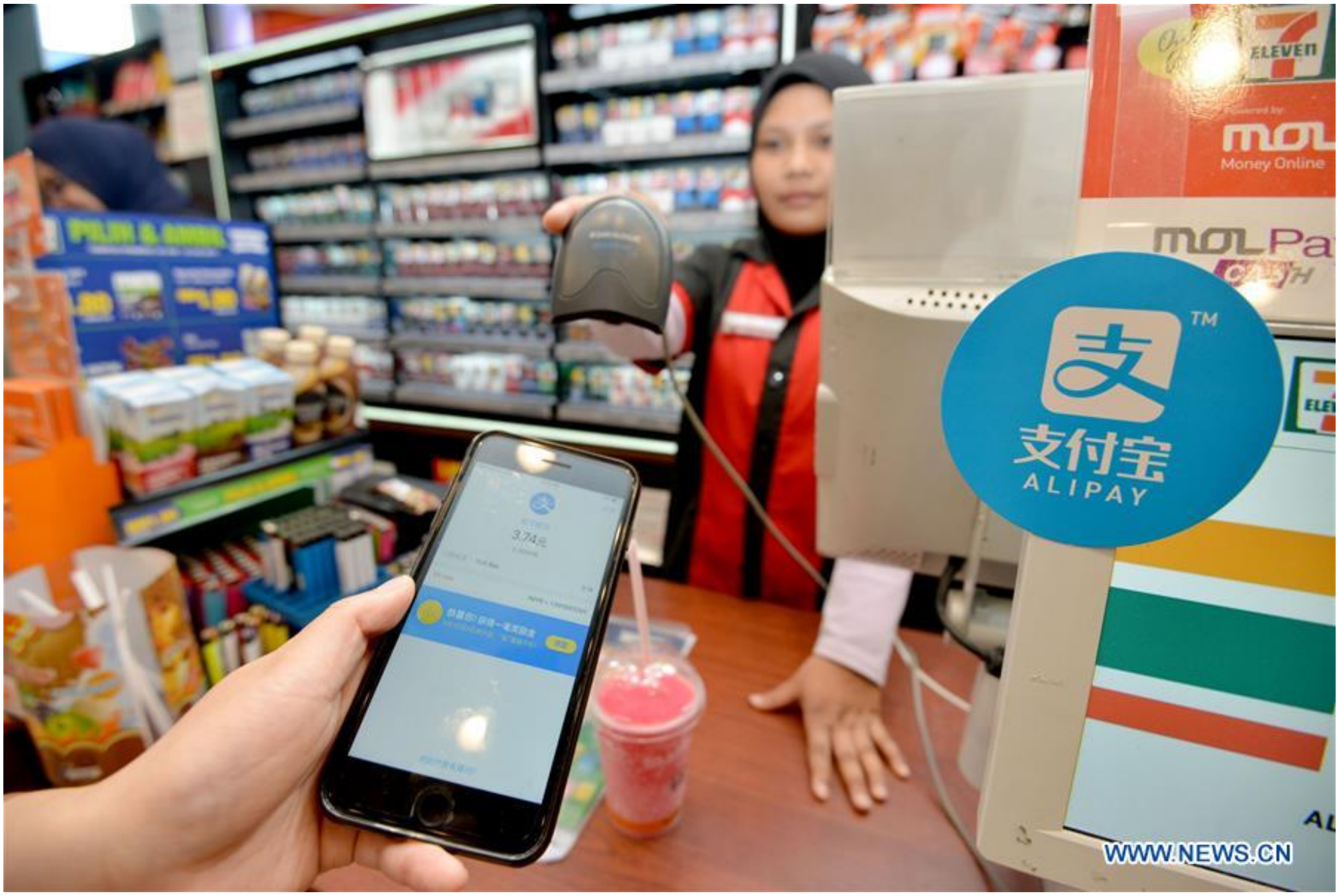
Despite these restrictions, it is apparent that governments are beginning to adjust their laws and regulatory frameworks to encourage the growth of FinTech businesses. Financial markets that are efficient are directly related to increased economic production, which is a significant incentive for both developed and developing countries.

China

Objectives:

- Students will be able to describe the unique factors driving the rapid expansion of FinTech in China
- Students will be able to discuss the underlying rational of FinTech 3.5

Customers' ideas of who can provide a financial service in China have already been distorted by technology. Money deposits for payments are no longer confined to bank deposit accounts. Holding customer deposits has traditionally identified an institution as a bank, triggering the associated licensing and regulatory requirements. AliPay handles over one million transactions each day using technology, and although such a figure resembles that of a regular bank, AliPay is not one. By creating almost three million direct and indirect job opportunities and supplying almost half a million SMEs with loans, Alibaba has also met two major government policy objectives. Banks should be permitted to respond to the competitive threats provided by less regulated firms that might acquire significant market share by delivering near alternatives for services in the interests of a fair playing field.



Since 1978, China has been steadily modernizing its financial system. The Great Financial Crisis of 2008, on the other hand, dampened politicians' and regulators' appetites for additional large-scale change, as the crisis shattered public perceptions of what makes an effective financial system and how institutions should be governed. Indeed, since 2008, legislation in China has tightened the regulatory environment for banks, reversing the trend toward a free market. This is mirrored in the West by rising compliance costs as a result of newly enacted national legislation (like as Dodd-Frank) or international norms.

In China's technology-driven financial transformation, there is a once-in-a-lifetime chance. China may surpass financial regulation norms by developing a regulatory framework that encourages and regulates FinTech and internet finance businesses, in addition to learning from Western regulatory failures. China's FinTech leadership is already visible in numerous ways. In March 2015, AliPay introduced face recognition payment, which was quickly followed by MasterCard in July 2015. Similarly, Alibaba's SME financing, which began in 2010 using alternative credit-scoring data, is now employed in the United States and Japan, as well as in Europe by Amazon.

Certain aspects of the Chinese market, notably its limited physical banking infrastructure and strong technological penetration, make it an ideal field for FinTech. There have been over a hundred million new internet banking clients in the last three years, a 24% rise in new personal bank accounts, and a 29% increase in online payments. By 2025, there are anticipated to be 1.3 billion digital banking users, and by 2022, over one billion Chinese citizens will have their credit scores based on alternative data sources (Sesame Credit Management).

The tension between traditional digital financial services and FinTech 3.0 providers is expected to be highest in the following three sectors in the future: (1) payments, (2) financing, and (3) deposits, with the last being the most contentious (and perhaps the main threshold for strong regulation).

To aid this digital transformation, banks should be able to compete on a level playing field with start-ups that provide near alternatives for regulated goods in terms of regulatory burden. Simultaneously, start-ups should be allowed to operate within a regulatory framework that permits them to grow their business without incurring high compliance expenses. As a result, setting threshold levels at which institutions must comply with legislation may be the way ahead.

As a result, the path forward may not necessarily rest in defining regulations for financial products, but rather in establishing threshold levels for when institutions must comply with small-actor conduct standards or prudential rules for bigger players. This might save time and money by avoiding onerous regulations with high compliance costs and minimal benefits to financial stability. This would also aid in defining the operational border between banks and internet finance firms, as well as determining if the distinction is made on the basis of goods or transaction size.

China's present standards appear to be heading to a two-tiered market characterized by transaction values. This is an unsatisfactory solution since it restricts the expansion of internet finance companies, but it may bring some regulatory consistency between banks and startups. This is reflected in Asia's development of tiered licensing systems, with governments creating "light license" models to reduce regulatory and compliance costs for businesses wanting to provide specialized banking services to specified demographic groups. South Korea, for example, is developing a special regime for online-only banks, India has created a new license type for payment banks and recently issued 11 new banking licenses, and China is introducing new private banks to serve market sectors that have traditionally been underserved by state-owned banks.

These developments are significant because they reflect the region's FinTech dynamics and show a regulatory strategy that encourages the growth of certain sub-sectors in order to achieve national policy goals.

Africa

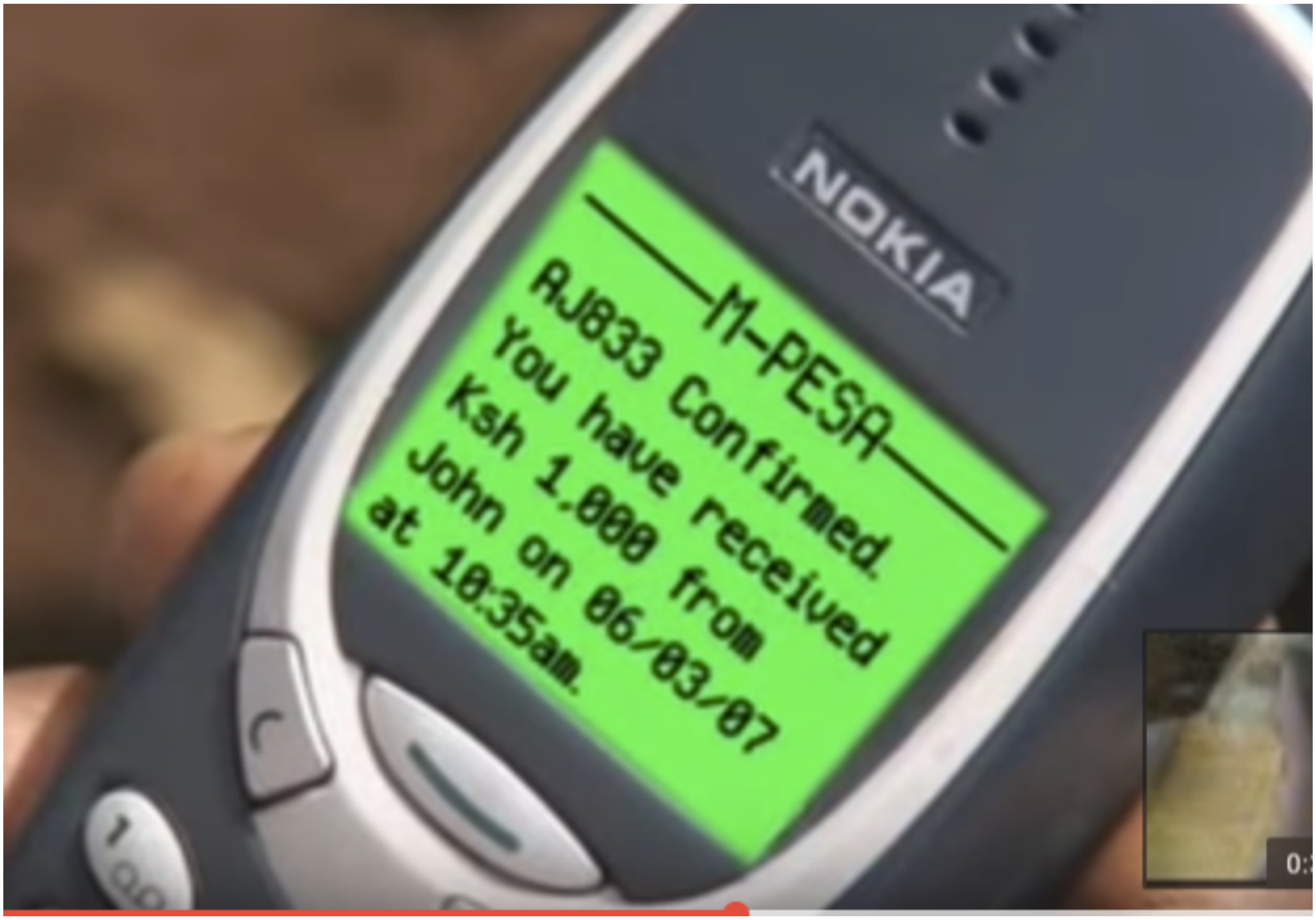
Objectives:

- Students will be able to describe the unique factors driving the rapid expansion of FinTech in Africa
- Students will be able to discuss the underlying rational of FinTech 3.5

FinTech arose in Africa around the dawn of the twenty-first century, owing to two factors: a lack of sophisticated banking and financial institutions, and the fast proliferation of mobile phones. In terms of FinTech development, Africa shares many similarities with the APAC region; nevertheless, the type and direction of the major advances in this field in Africa have been rather different.

In comparison to 64% of Asian families, just 22% of African households have access to formal or semi-formal financial services. As a result, telecoms firms have been at the forefront of FinTech innovation. Mobile money, which provides basic payment and savings services using e-money stored on a mobile phone, has been most successful in Kenya and, more recently, Tanzania. By allowing users to save money, send money safely to their relatives, pay bills, and receive government payments securely, mobile money has substantially boosted economic development.

M-Pesa, Safaricom's mobile money product, which was introduced by Vodafone in 2007, is Africa's most well-known success story. Payments made through the network have already exceeded 47% of Kenya's GDP in less than five years, and the central bank is now required to closely oversee the provider since the payments platform has become systemically critical.



Undeniably, the phenomenal success of M-Pesa has caused problems elsewhere, with screen savers on every corporate computer warning – "Be aware – we are not in Kenya now" – because providers in many other countries have had to learn that simply replicating what was done in Kenya will not necessarily lead to similar customer take-up of digital financial services. For digital financial services (DFS) to thrive, the services provided must be precisely suited to local requirements. Meeting the requirements of local customers, whatever they may be, is a fundamental prerequisite for success in delivering DFS – yet this is not the starting point for many of the individuals creating DFS solutions, who come from an IT background, as they most frequently do.

Thus far, Africa's FinTech journey has primarily consisted of the supply of mobile money services that enable the fundamental functions of payments and savings, as well as the more recent addition of higher-order services such as credit and micro-insurance.

Why Scientific Libraries?

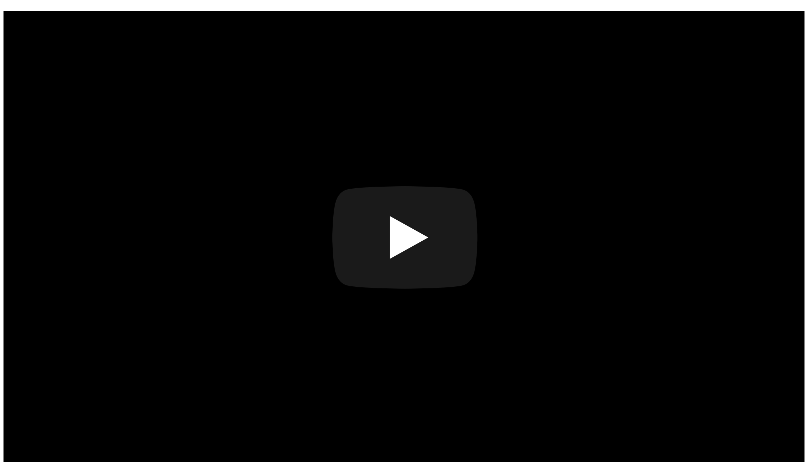
Objective:

- Students will be able to describe the benefits of scientific libraries for FinTech programming

---

The original use of programming languages was to make mathematical computations more efficient and automated. The earliest algorithms were designed to compute logarithms, which help turn multiplication problems into addition problems. The concepts of efficient computation are still an important application of any programming language. However, the most advanced and efficient methods to are often not built in base general-purpose languages such as Python.

A large amount of data science and machine learning is built on a few specific branches of mathematics. Specifically, Linear Algebra and Statistics. Linear Algebra deals with computation involving matrices. The Python libraries used to conduct efficient matrix calculations are called Numpy and Scipy.



NumPy

Objective:

- Students will be able to describe the role of NumPyFinTech programming

---

NumPy is a library for Python that supports large multidimensional arrays and matrices. Later on, we will manipulate datasets using the Pandas library which is built around NumPy. NumPy has a lot of utility and is able to perform complex mathematical operations quickly and efficiently. In Machine Learning using Python, these arrays will be the data structure used for handing off our transformed data to our Machine Learning algorithm with the help of Scikit-Learn.

Learning the basics of NumPy will help you become a data manipulation master and is a fast way to perform large amounts of matrix operations locally.

Additional Resources:

- Documentation
- NumPy Reference PDF
- Wikipedia
- Chapter 2: Introduction to NumPy

Introduction to Regulation & Supervision

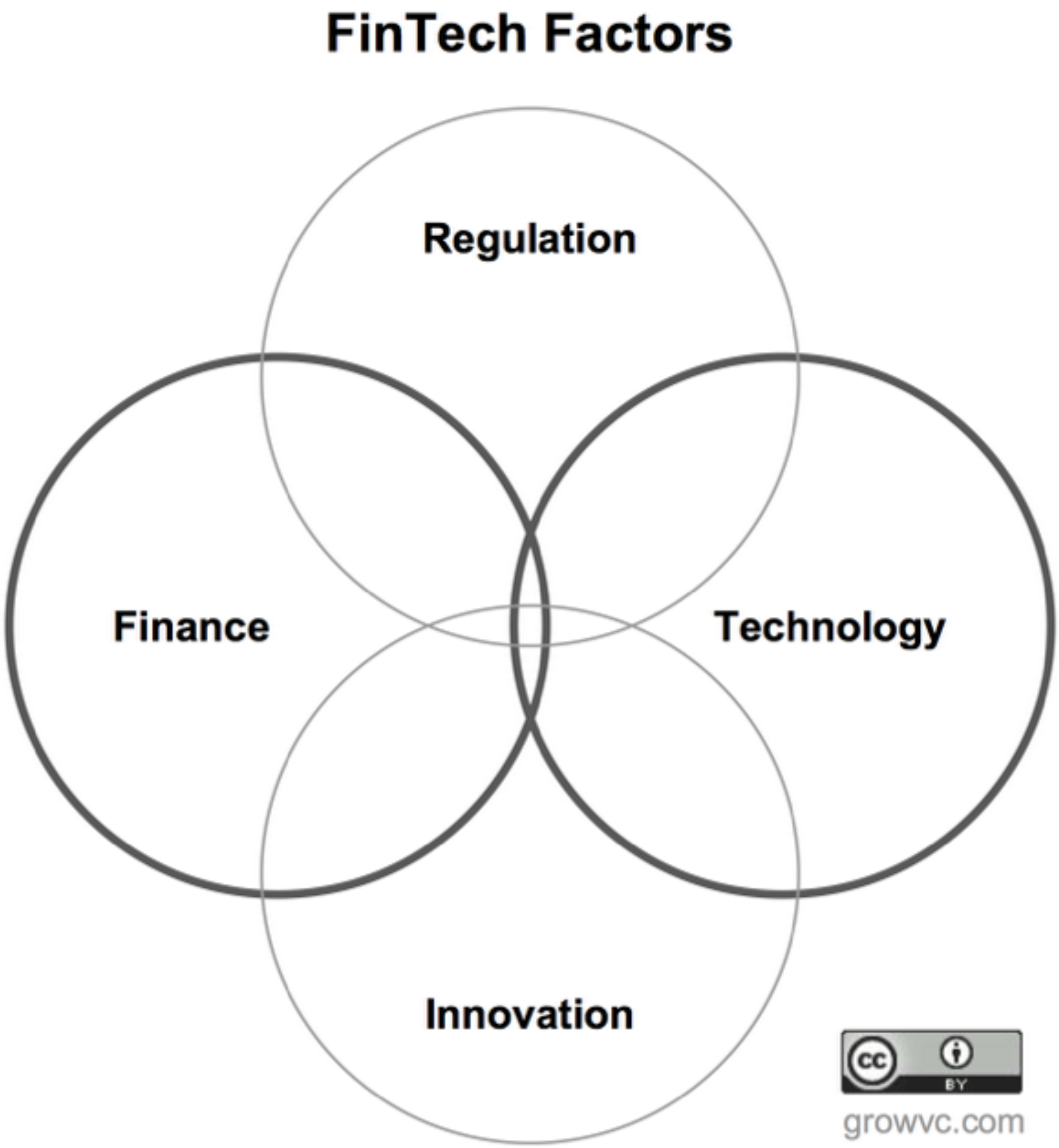
Objectives:

- Students will be able to discuss the broad regulatory response to FinTech
- Students will be able to identify and describe the four FinTech Factors presented in this lesson
- Students will be able to describe the stage to innovation diagram and its underlying concepts

---

The regulatory response to FinTech is shifting away from high-level principles – such as the ten "considerations" for banks and supervisors outlined in the Basel Committee's February 2018 sound practices paper on the implications of FinTech developments – or reliance on existing legislation and rules, and toward a more detailed application of new rules and guidance to the specifics of FinTech-related activities.

Although there isn't currently a one-to-one mapping of regulatory actions to each identified risk, based on historical performance, we may expect regulators to get close. Despite the rising number of sets of international FinTech principles and standards, national implementation of these concepts and standards is still uneven and inconsistent, with some nations enacting highly comprehensive rules in certain sectors.



Sandboxes, incubators, and accelerator programs are where start-ups develop their solutions, and here is where FinTech 3.0 breakthroughs emerge. Graduating from one of these accelerators indicates that the firm has matured to some level as a result of its involvement in a structured program. These firms are then partnered with, invested in, or acquired by banks.

There are also benefits for regulators, since the FinTech 3.0 model challenges their old practice of just looking at existing financial institutions that begin to deploy goods or services on a large scale. Regulators used to be able to rest easy knowing that regulated financial institutions with which they already had a relationship would manage innovations appropriately; however, this is no longer the case.

A good example is money market funds (MMF). Vanguard, Fidelity, and Schwab, three of the industry's biggest companies, were founded in 1975, 1946, and 1971, respectively. Alibaba launched a new MMF in 2014 that was completely online and open to its existing client base. Yu'E Bao surpassed decade-old players like Vanguard and Fidelity as the world's fourth largest MMF in just nine months.

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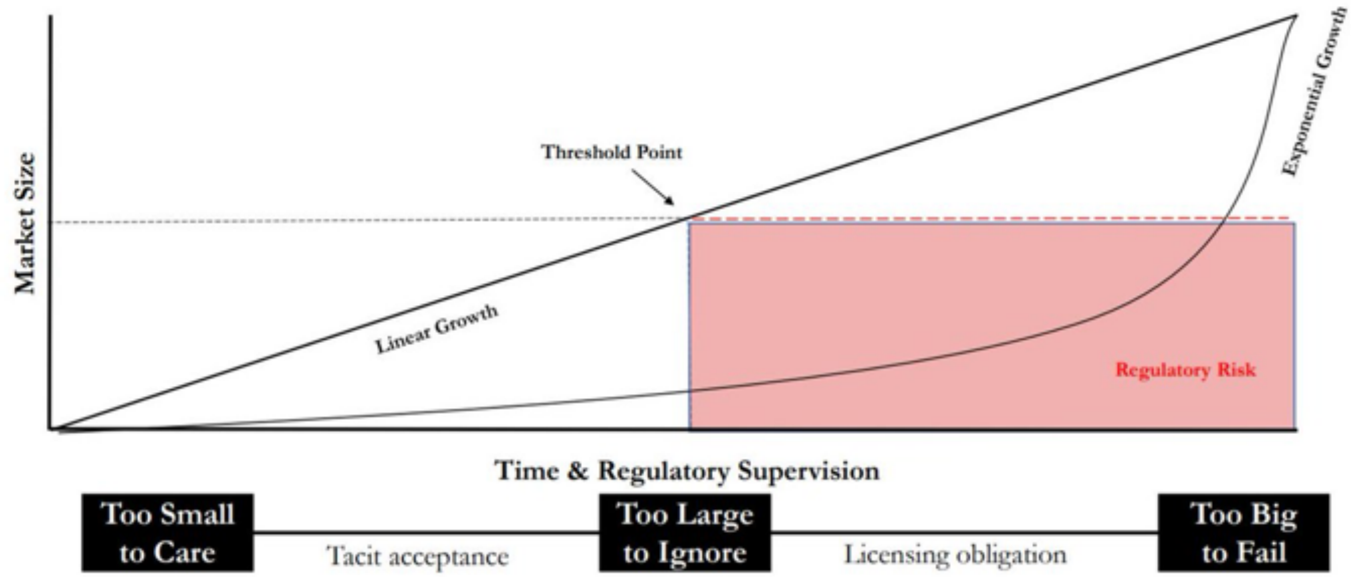
Yu'E Bao demonstrates how, in just nine months, a non-traditional financial institution moved from "too tiny to care" to "too large to fail." This exponential expansion poses a direct threat to the otherwise more progressive method of regulating innovations and stakeholders, skipping the "too-big-to-ignore" phase where regulators would have begun to contact and require compliance from such organization.

Stage to Innovation Regulation



In other words, if the proper strategy of mainly regulating actors having a large influence on financial markets remains the correct approach, which we believe it is, what may need to alter in exceptional situations are the tools used to detect future systemically important actors in time.

Given the magnitude of the investment and the competitive consequences of these new participants in the financial services sector, regulators in various jurisdictions must examine the best approaches to supporting FinTech and modify their regulatory methodologies (e.g., rule or principle-based).

Regulation

Objectives:

- Students will be able to discuss the myriad ways in which regulators respond to FinTech

---

FinTech regulators respond in a variety of ways.

1. Regulatory edge

Some FinTech developments, such as the use of crypto currencies, cloud computing outsourcing, and the expansion of some non-financial services firms into the provision of specific products and services, such as lending to SMEs and retail payment systems, raise questions about where the regulatory boundary should be drawn. The regulatory net is spreading, and some companies that are now outside the perimeter may soon find themselves regulated.

The severity of regulation may grow as the regulatory net spreads. Regulatory standards for loan-based and investment-based crowdfunding, for example, have evolved to broaden from their early focus on clear disclosures and risk warnings to funders. These criteria have changed to an emphasis on service providers having capital-type resources to safeguard funders in certain scenarios, as well as putting in place sufficient credit risk assessment, governance, systems and controls, and complaints handling processes. This is mirrored in FinTech credit license application guidelines, which emphasizes governance, internal controls, operations, capital, and liquidity.

2. Retail conduct

In the FinTech age, regulators are using a combination of

(a) transparency in order to raise the awareness of the consumer regarding the nature and risks of products and services,

(b) prohibiting or limiting the sale of certain products and services to retail customers, and

(c) rewriting detailed conduct of business requirements to adapt them to FinTech developments.

3. Data & AI

Some of the data privacy problems raised by FinTech are already covered by current data protection laws, such as the EU General Data Protection Regulation (GDPR). However, FinTech developments are constantly highlighting new areas where additional or revised regulation may be required, such as the use of artificial intelligence and distributed ledger technology, as well as the general trend toward the collection of an ever-larger range of financial and non-financial data from, and sharing across, a wider set of parties. A more heated debate is expected over whether suitable frameworks for data collection, storage, sharing, and usage, both domestically and cross-border, are in place.

4. Governance of regulated firms

Regulators are progressively enacting regulations or recommendations aimed at ensuring that boards of directors and senior management have a sufficient grasp of the FinTech applications utilized by the firm in order to properly manage risks. Some authorities are also demanding firms to define specific senior management duties and accountability for addressing FinTech-related risks.

Some authorities are concentrating on board and senior management duties in specific risk areas, including as algorithmic trading, cyber security, outsourcing to third-party service providers, and operational resilience in general, as part of this strategy.

5. Risk management

Despite the fact that most FinTech innovations are covered by current risk management regulatory standards, some FinTech advancements have prompted regulatory reactions requiring regulated businesses to handle particular FinTech-related developing risks within their risk management framework. This has included the risks of money laundering and market manipulation associated with the use of crypto assets; the risks associated with the use of distributed ledger technology in payment, clearing, and settlement systems, and more broadly in the storing and validation of transaction data; the application of outsourcing principles to specific FinTech applications such as cloud computing and artificial intelligence; and the application of outsourcing principles to specific FinTech applications such as cloud computing and artificial intelligence.

6. Cyber Security

In the key areas of governance, workforce skills and capabilities, identification (risk analysis and assessment), protection and detection (access management, information security, security controls, expertise and training, monitoring and testing, and information sharing), and incident response, regulators are focusing on the national implementation of international standards (crisis management, recovery and learning lessons).

Supervision

Objectives:

- Students will be able to provide the common FinTech-related areas that supervisory decisions a

Supervisors are increasingly considering FinTech-related concerns while making supervisory decisions areas like as cyber security, outsourcing, operational resilience, and anti-money laundering (AML). The "basics" of how regulated businesses identify, analyze, and manage the risks posed by FinTech. Super companies address these risks in their strategic and business planning, new product approval and out management practices in general; and how companies monitor and review the impact of FinTech on t applicable regulatory requirements, such as consumer protection and data protection.

Supervisors are concentrating (to varied degrees in different nations) on:

1. Business models and viability

If a company has a well-thought-out strategy and business model that takes FinTech advancements ir solid foundation for the company's long-term profitability and sustainability.

2. Governance

how effectively boards and senior management understand FinTech and the dangers it poses, and ho analyzed, and mitigated these threats.

3. Risk management function

Whether firms (and, more importantly, their supervisors) have reshaped their internal organization in r developments, with adequate resources and clear reporting lines across all three lines of defense; and technical capabilities required to manage technological innovation, including hiring for appropriate sk mathematicians, and statisticians.

4. Conduct

If firms are adopting a broader perspective of how FinTech may be affecting the risks faced by custon be managed, in addition to complying with specific precise legal criteria

5. Outsourcing

Whether businesses have enough control over third-party providers, including access and audit rights outsourcing for business continuity, recovery, and resolution planning.

6. Cyber Security

Whether businesses can show they have strong governance, risk identification, security controls (inclu incident management, network security, and end-user computing), detection and prevention, testing, information sharing in place.

Furthermore, major corporations are likely to move beyond meeting basic requirements to implement as technology and risk management tools) to better manage cyber risks and to drive innovation in pe and information sharing to improve cyber resilience.

7. AI & ML

How successfully companies manage and mitigate the risks that arise when they utilize AI and machin extensively, particularly in terms of governance, knowledge, and partnerships with third-party supplie are being challenged to show that they understand and can successfully manage the dangers that inc may bring.

Regulatory Barriers

Objectives:

- Students will be able to describe how regulatory barriers can impede innovation in FinTech
- Students will be able to identify common regulatory barriers
- Students will be able to discuss ways in which the UK government is addressing regulatory barriers for FinTech

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A number of analyses have been released that address regulatory impediments to innovation, the need for regulatory toolkits, and the need of putting innovation at the center of regulation. The majority of these are concerned with financial technology and regulatory support for innovation. The Financial Conduct Authority (FCA) has responded positively by creating Project Innovate and soliciting feedback, as detailed below. "Financial sandboxes" to test innovative financial concepts with the broader public are among the FCA's initiatives under consideration.

The time and expense of registering and complying with laws, as well as the possible repercussions if they don't, deter many financial institutions and FinTech businesses from innovation and entrepreneurship. This is particularly difficult for FinTech start-ups, who must register before they have fully established and proven their business strategy. As a result, the FCA is offering “fast-track” registration to start-ups with which it is working.

In a broader sense, as part of its Digital Transformation Project, the UK government has released a number of digital services and is presently developing others. HM Treasury is working on a bank-specific open standard API. The European Commission launched a Digital Single Market Strategy in May 2015.

RegTech

Objectives:

- Students will be able to define RegTech
- Students will be able to describe the impact of technology on regulatory authorities
- Students will be able to discuss how PayPal is supporting smart governance

Rapid technological advancements are allowing financial services businesses to operate in ways that were just not conceivable 15 to 20 years ago. However, these financial innovations take place inside a regulatory framework that is straining to keep up. Regulatory authorities may now access a degree of granularity in risk assessments that was previously unavailable due to the growing use of technology in the financial services industry.

This idea of a data-driven regulatory structure isn't entirely new. Regulators, business, and academics have all been paying more attention to this since 2007. Peppet released a study on "smart mortgages," which utilize data to reduce default risks, in 2009, when the SEC formed the division for Economic and Risk Analysis to look at leveraging data insights for improved regulation. However, one must weigh the advantages of technology against the practical hurdles to real and successful application, which are described further below.

The emergence of regulatory attention in the FinTech sector marks a watershed moment. Regulators are no longer focused only on preventing the last catastrophe; instead, they are considering how to promote future market growth while ensuring financial stability. Even if they are not yet big or capable of (now) complying with the regulations, early contact with emerging FinTech start-ups has advantages for regulators. This gives authorities the ability to understand the business models of FinTech 3.0 start-ups and the people driving them from the outset (so as to see whether they are fit and proper for that role). Various jurisdictions have used this method. For example, the Financial Conduct Authority (FCA) in the United Kingdom not only launched a survey to better understand the regulatory challenges that FinTech 3.0 businesses face, but it also added an innovation hub to interact with and encourage creative start-ups at an early stage.

The amount of work and resources authorities are devoting to studying the

FinTech industry is probably unexpected, especially given that they are revisiting some of the same concerns and dangers that were discovered with e-banking over a decade ago. Furthermore, except from specialized products (such as robo-advisory), FinTech businesses' business models are not much different from those of their conventional equivalents (e.g., P2P lending emanating from shadow banking in China). Lower overhead expenses, or disintermediation, are the most important factors driving efficiency. FinTech is, in some ways, going full circle and only delivering modest changes, both from an industry and regulatory standpoint.

Example: PayPal

PayPal supports the implementation of a new decision-making model known as SMART Governance to better achieve the aims of (payments) regulation in a way that benefits the government, customers, and business. To assess the performance of covered companies, SMART Governance combines the use of technology and data with a collaborative and iterative approach, resulting in a more informed regulation formulation process.

“Technology and data power this new model,” PayPal says, “but cooperation, creativity, and experimentation are the keys to unlocking insights from the data; it is the application of these insights that will result in better regulation.” We advocate for the implementation of Dynamic Performance Standards, which are regulatory rules that evaluate outcomes and iterate depending on fresh data and insights gleaned via a collaborative approach. Performance standards have failed to become the dominant regulatory paradigm in part because industry considered them to be excessively rigid and risky in terms of regulatory risk vs real-world adaptability. Dynamic Performance Standards utilize modern data analytics techniques, iteration and collaboration to overcome the traditional shortcomings of performance standards.”

Intro to Digital Banking & Payments

Objectives:

- Students will be able to provide an understanding of digital banking and payments
- Students will be able to explain the essential characteristics of rapid payment services that have an impact on their adoption

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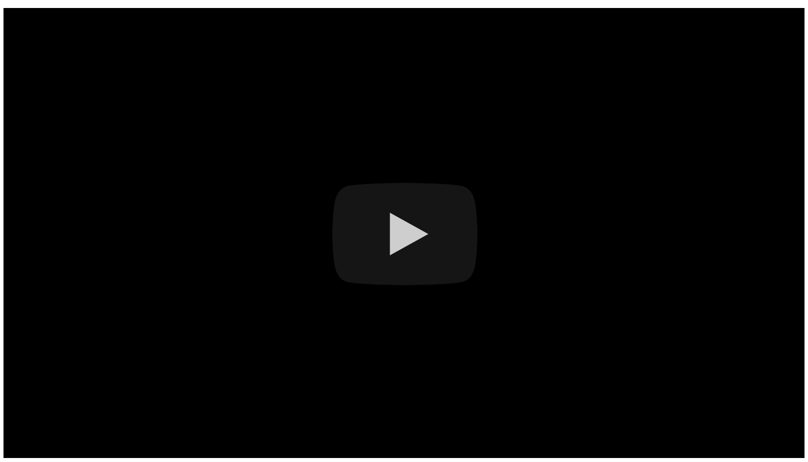
Although partnerships with FinTechs and in-house development are the two most popular options among industry players on a global scale, there are other desirable practices for the sector that, in addition to being part of a manual of good practices applicable to a hyper-technological and competitive environment, can serve as differentiators. One of them is a planned incorporation strategy, which aligns organizational goals while taking into consideration the resources and capacities of each unit individually.

Although some companies have taken steps in this regard, and there are digital bank initiatives planned for the future, the development of digital banking is still in its early stages. Different chances to enhance the growth of the financial system and expand its economic and social advantages arise under this new paradigm. Financial inclusion, or the greater integration of individuals into the financial system (onboarding); the abolition or replacement of bureaucratic processes with more agile ones; the reduction of transaction costs, which will allow digital banking to offer its products at a lower price than traditional banking (creating more competition); and a focus on the customer.

FinTech adoption is not difficult, but it does need the bank's willingness to modify certain processes. A large majority of banking and financial services executives believe that digital technology will have a disruptive impact on their businesses.

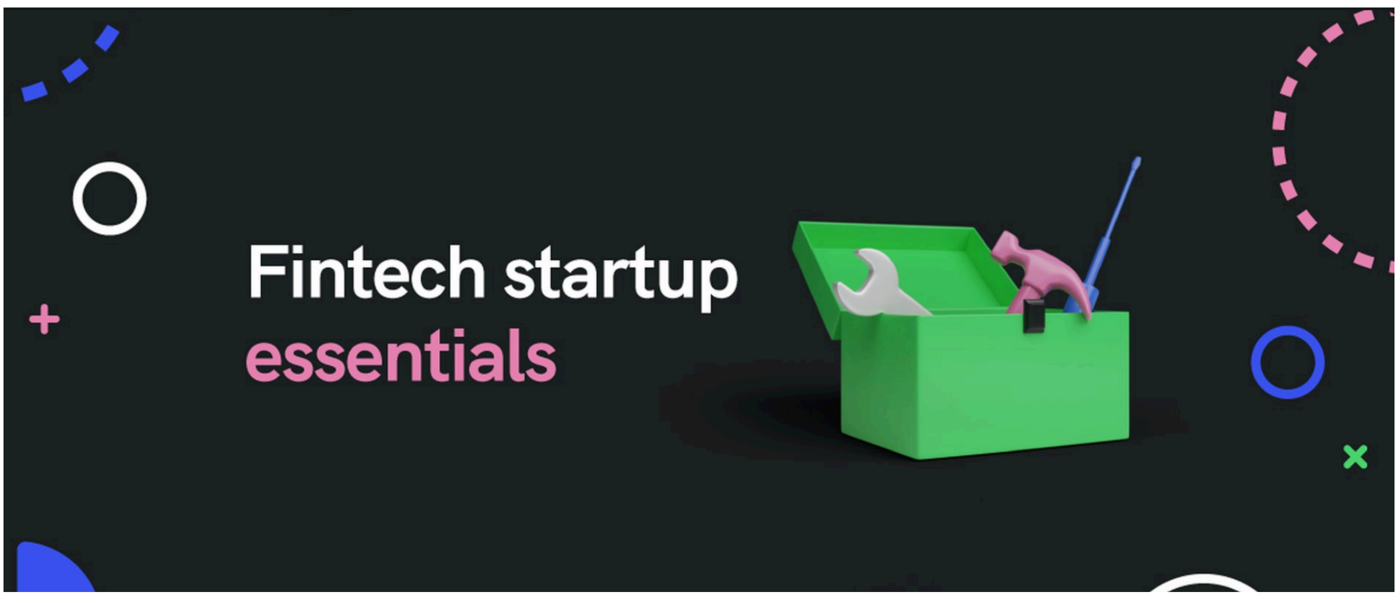


The challenge for new digital banks is multi-faceted: on the one hand, adapting to the country's regulatory framework, which frequently acts as an entry barrier; on the other hand, having the financial capacity to cover all business risks, even in stressful scenarios, and to capture profitable sources of financing, all while working to earn the client's trust. Traditional banks, for their part, face a similar challenge: they must instill a customer-centric digital culture in their collaborators and employees, as well as integrate new digital processes into risk management and create an agile structure that allows them to adapt processes and developments at the same rate. In addition, if the financial institution decides to integrate a FinTech, it is critical that the new company follows the same procedures and culture as the old one.

Loans, crowdfunding, investments, financial advice, insurance, payments and transfers, digital currencies/blockchain, and computer security are all part of the FinTech sector. One of the goals is to develop the connection with banks based on a cooperative partnership, offering services and complementing capabilities in order to achieve synergies between financial organizations and FinTechs, which would allow the market to open up and flourish. The world is changing, and the word FinTech keeps cropping up in that new wave that has already come owing to technology.

What are the essential characteristics of rapid payment services that have an impact on their adoption?

The stages for a bank to become a dynamic FinTech startup are as follows:



Clients must be properly understood: This guidance is crucial because, while serving a wide range of customers, banks must be clear about their capabilities. To put it another way, they're millennials, the microfinance industry, or auto loans. With a thorough understanding of who the client is, a plan can be developed to cater to that specific group and therefore specialize.

Banks must collaborate with technological firms in order to be more active in the market. Although collaborating with a startup is a fantastic idea, it's important to understand the competitive advantage that an alliance will bring, because an agreement isn't simply about shaking hands. When a bank collaborates with a startup, it must manage research and development resources and, as a result, create a new system. This does not ensure success, because the only way to know if you have favorable or bad outcomes is to commit a significant amount of time and money.

Banks that are devoted to financial disruption seek to energize their respective communities. What are their methods for accomplishing this? Creating a culture that values frequent input and encourages innovation. This appears to be an easy task, yet it necessitates the use of techniques.

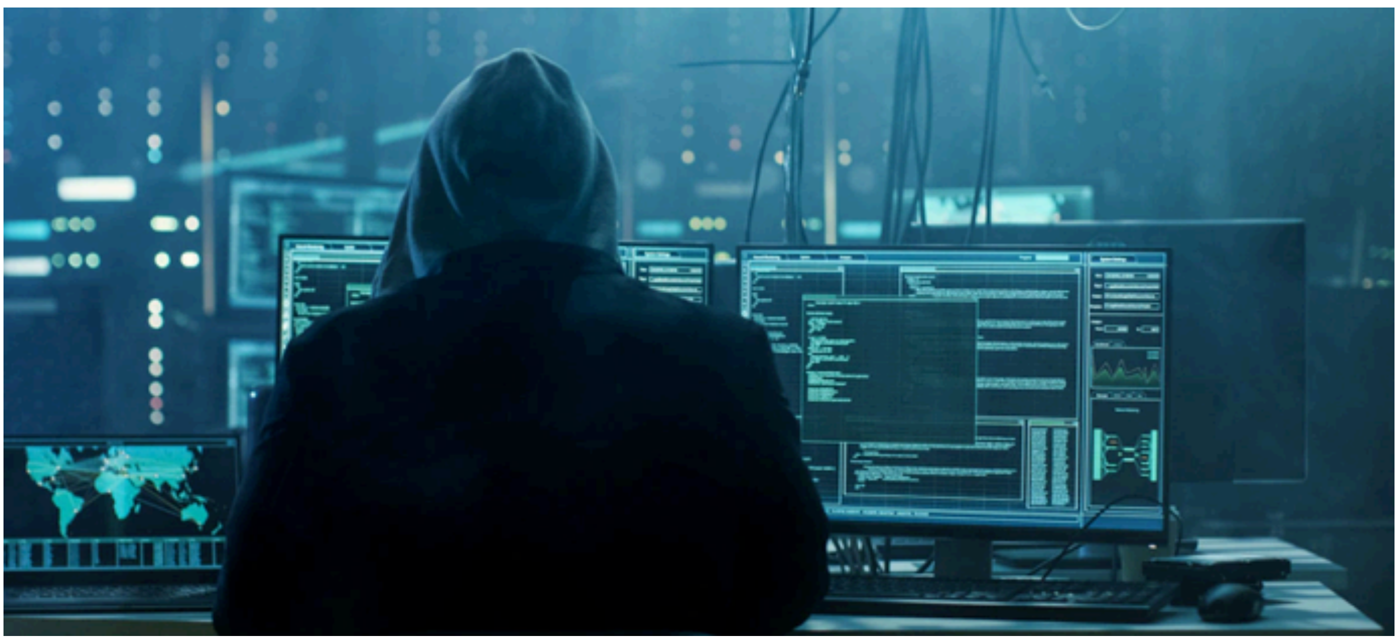
Is FinTech and digital payments solely significant for consumer payments? What are the possibilities for Business-to-Business payments with digital payments and FinTech?

The Financial Stability Council defines FinTech as a technology-driven process of financial sector innovation. As a result, new procedures, apps, and business models are being developed to transform the way financial services are produced and distributed. Established businesses are transforming as a result of new technology, and new entirely technical financial services companies are emerging.

Market infrastructures are nuclei that enable multilateral relationships between economic players by facilitating transactions between them. Its worth is derived from the extent of its connecting power. However, given that the collapse of one entity might spread to others, disrupting numerous financial exchange activities with significant implications for the actual economy, this is also where its systemic importance resides. Payments, as previously indicated, are currently in the crosshairs owing to the current wave of innovation. As a result, several online trading platforms include incorporated payment systems. Its usage is tied to the platform, but if it expands significantly or forms partnerships with other businesses, it may establish a virtual money circulation that runs parallel to legal money.

The usage of digital currencies connected to products distribution networks does not appear to be a fad in a world where online transactions are continually expanding and extend to non-durable items for daily use. Financial regulators and supervisors, as well as international organizations, are already keeping a close eye on technological advances, and the word FinTech is giving way to the term RegTech, which means that new technology will make it easier to oversee the financial sector.

Could FinTech play a key role in combating new payment fraud trends?



Technology has enabled a system revolution, and the financial industry is no exception. Many institutions have enhanced their services as a result of this progression, and users have benefited financially as a result of it. As a result of new technology advancements, FinTech businesses have produced disruptive and creative goods and services. Financial Fraud has also entered this revolution and has been evolving, which is why it has become increasingly sophisticated and complex, especially since it is no longer necessary to have a physical card to commit financial fraud. Issues such as identity theft and the extraction of personal data are important points to combat.

Scammers and fraud detection systems are always at odds. Scammers perfect their art by researching new methods to get over any barriers put up to keep them out, while fraud control solution suppliers are continuously inventing new technologies. Mule scams, for example, used to be quite straightforward, with scammers relying on basic packet redirection to get their stolen items. Today's mule scams, on the other hand, use social engineering to target potential victims. Scammers are now focusing on three major e-commerce consumer touchpoints: shopping, payment, and recovery, as well as investing more time and money to grow their operations and enhance their return on investment. In each of these phases, they must look to be real clients, therefore they are focusing their efforts on identifying new weaknesses.

Lending & Borrowing

Objectives:

- Students will be able to provide a basic explanation of lending and borrowing as they relate to the FinTech Ecosystem
- Students will be able to describe the new challenges in FinTech lending

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Lending is another important aspect of the FinTech Ecosystem.

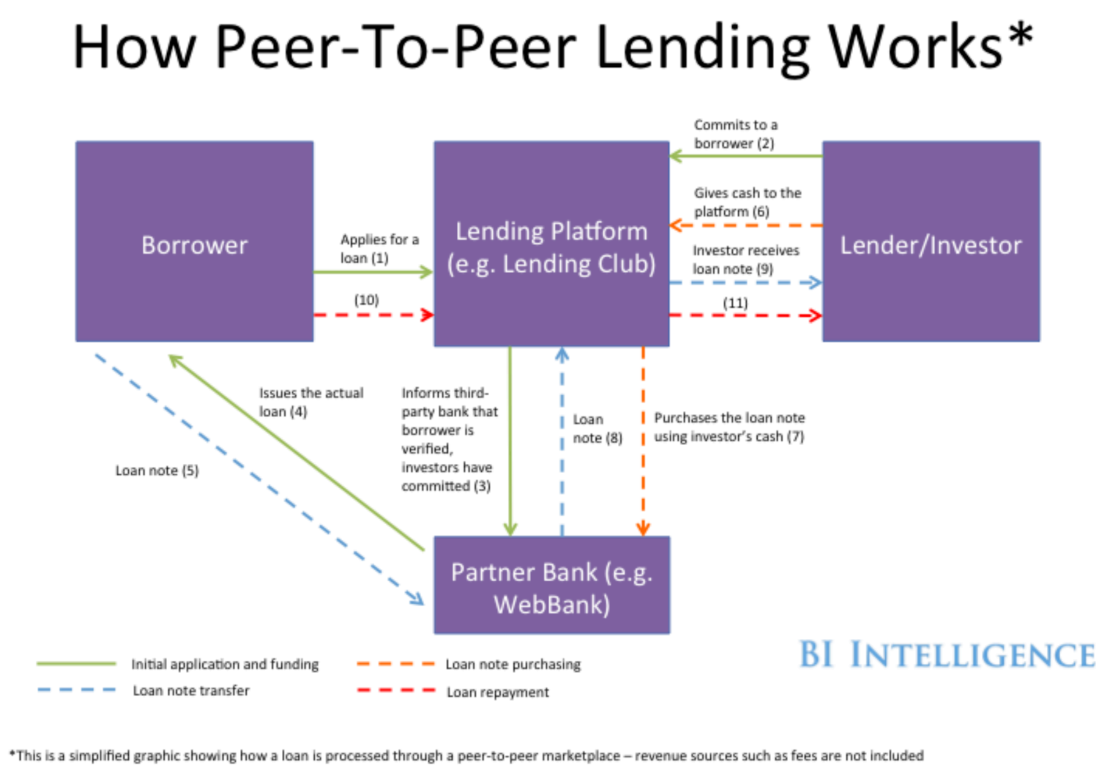
This innovation is transforming traditional consumer and business financing, such as acquiring a mortgage loan online. Many FinTech lenders find new borrowers, assess their risk, and then establish loan conditions, including the interest rate, using proprietary technology, machine learning algorithms, and Big Data analytics. The wonderful thing is that this can frequently be accomplished in less time than it takes to prepare a pot of coffee.

This segment of the Ecosystem may be divided into three categories:

1. online exchanges (such as Lending Tree),

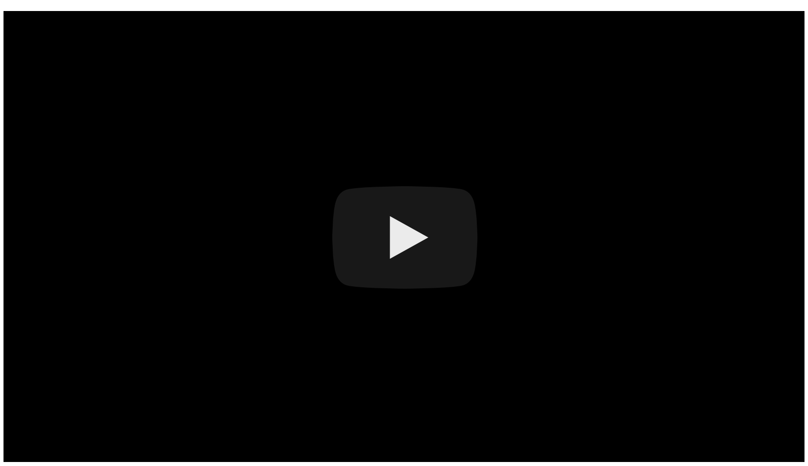
2. online lenders (such as Quicken Loans' Rocket Mortgage),

3. peer-to-peer (or P2P) lenders (such as Lending Club).



The third category represents a novel borrowing and lending method. Initially, P2P lenders provided a platform for individual borrowers to enter their funding requirements, and instead of going to a bank or other lender for a loan, the funds were borrowed directly from other individuals or groups of individuals who were looking for an alternative to buying stocks or bonds or putting their money into a savings account. As a result, P2P lenders linked borrowers in need of money with “peer” lenders, or private investors. This is an example of disintermediation, which is an underlying principle in FinTech economics that should be taken into account while analyzing creative startup company strategies.

In recent years, there has been a movement toward what is known as reintermediation. Since its inception, the business model of these peer-to-peer lenders has evolved. Individual investors provide a tiny percentage of their funding in the form of micro-loans, but the loans are mostly supported by warehouse credit facilities from big financial institutions and then sold off as entire loans or packaged into asset-backed securities. As a result, peer-to-peer lenders are now referred to as Marketplace Lenders (or MPLs). This was referred to as reintermediation, as it reversed the process of disintermediation. CommonBond is a forward-thinking company that falls between an online lender and an MPL. That business uses technology, Big Data, algorithmic risk models, and the securitization market to assist college graduates refinance student loans at competitive rates.



FinTech lenders that are able to weather the storm will likely be in a strong position to raise more money and exit successfully once the global economy improves. While it is not the newest nor the trendiest vertical, there is a lot of exciting innovation going on in this sector, so it has a lot of room for growth.

Crowdfunding

Objectives:

- Students will be able to provide a definition for crowdfunding
- Students will be able to describe the different types of crowdfunding platforms and how they impact crowdsourcing respectively

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Equity crowdfunding is the equity-based counterpart of peer-to-peer lending, as mentioned above. Indeed, we like to compare the differences between P2P lending and equity crowdfunding to the differences between debt and equity in capital markets. Unlike peer-to-peer lending platforms, which enable individuals to borrow money from others wanting to invest their money, equity crowdfunding platforms allow individuals and organizations to raise cash by offering investors a share in the project's success. The potential upside return on investing through these platforms ranges from a direct ownership position with profit sharing to “paid in kind” rewards, in which investors receive items or other prizes in exchange for supplying cash. The crowdfunding site may specialize in generating funds for philanthropic reasons in some circumstances.

Crowdfunding is defined as "an open request for financial resources, mostly over the Internet, in order to support initiatives for specified reasons." Crowdfunding is defined as the attempts of enterprising individuals and groups–cultural, social, and for-profit–to raise funds for their enterprises by soliciting modest donations from a large number of people over the Internet. Crowdfunding is based on the concepts of microcredit and crowdsourcing. It is a unique type of fundraising in which capital seekers (fundraisers) are connected with capital givers (investors) via a crowdsourcing middleman (platform).

Various types of crowdsourcing have evolved during the last five years. We can distinguish between investment and non-investment crowdfunding methods based on the risk of funding for investors. Crowdfunding platforms may be further classified within these two types based on the rights of crowdfunders in the project's outcome:

- **Crowdfunding based on lending**: funds are repaid, and funders are entitled to a legally agreed-upon interest payout. This model is further divided into two sub-models: (1) peer-to-peer lending (P2P), which is defined by direct contact between the two parties, and (2) social lending, which is often utilized for small-scale entrepreneurial initiatives.

- **Equity-based crowdfunding** is when money is given in return for a company's stock. If the firm does successfully, investors have the right to earn returns on their investments.
- **Funds are donated** in exchange for non-monetary advantages in reward-based crowdfunding. A modest gift (reward) or a reservation for a product that is still in development are common perks (pre-order).
- **Donation-based crowdfunding**: money is given without expectation of payment for charitable or sponsorship purposes.

Crowdfunding platforms may also be divided into broad categories. Vertical (or theme) platforms focus on crowdsourcing for initiatives within a certain subject or industry, whereas generalist platforms offer crowdfunding for any area of interest.

Finally, the various financing techniques used by crowdfunding sites may be differentiated. Platforms can set pledge levels, minimum investment quantities, and whether or not to finance on a "all or nothing" or "keep it all" basis. The “all or nothing” financing strategy ensures that project proponents receive cash only if the campaign meets its goal in full. Investors get their money back if the goal amount is not met. The “keep it all” funding model, on the other hand, permits project proponents to receive whatever amount gathered. Ironically, of all the FinTech sectors, crowdfunding businesses have raised the least amount of money. According to Venture Scanner, less than $915.5 million was raised from 2010 to the first quarter of

2020. From 2016 through 2019, the annual average amount of financing was little over $112 million. In the whole Venture Scanner database for crowdfunding companies, there have been no IPOs and just 65 acquisitions. Tilt.com, a crowdfunding website launched in 2011, was acquired by Airbnb in 2017, and Circle purchased SeedInvest, an equity crowdfunding platform started in 2011. Circle is a FinTech firm that specializes on blockchain and cryptoassets. Indeed, the realm of cryptoassets, which is sometimes mistakenly conflated with FinTech, despite our ecosystem demonstrating that this is not the case, may be regarded as a way in which FinTech is transforming capital markets.

Digital Banking

Objectives:

- Students will be able to provide a basic explanation of digital banking & payments
- Students will be able to describe essential characteristics of rapid payment services that have an impact on their adoption

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The digital banking revolution is only getting started. We are currently in phase one, in which most conventional banks provide high-quality online and mobile sites/apps to their clients. Customers may use their smartphones or tablets to accomplish anything from create a new account and make payments to settling credit-card billing issues, all without ever having to step foot in a physical branch, in a different approach.

This is something that a growing number of customers throughout the world are requesting. More than 80% of respondents we polled in established Asian economies stated they would be ready to move part of their assets to a bank that offered a compelling digital-only offering. Consumers in growing

Asian economies accounted for more than half of the total. Many sorts of accounts are at risk, with respondents predicting that 40 to 45 percent of savings-account deposits, 45 to 55 percent of credit-card balances, and 40 to 50 percent of investment balances, such as mutual fund balances, will be affected. By 2022, digital sales might account for 55% or more of new deposits in the most progressive locations and client groups.

Many financial technology companies are already capitalizing on these opportunities by providing streamlined banking services at lower rates and with less fuss and paperwork. Some newcomers are offering totally new services, such as Digit in the United States, which allows users to locate tiny sums of money to save safely.

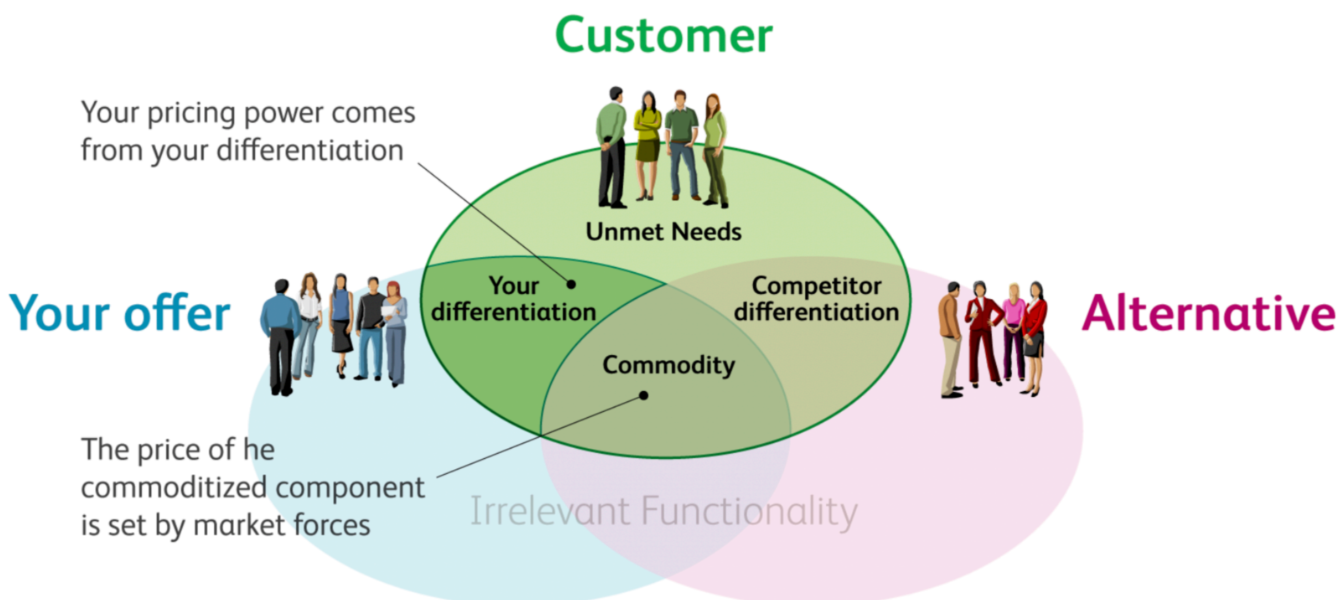
While it is critical for banks to digitize their existing operations, developing a new digital-only banking firm can rapidly and efficiently satisfy changing consumer expectations. This is especially true in fast-growing emerging countries, where conventional solutions frequently fail to meet client demands. The usefulness of digital products is restricted, and customers typically cite poor branch customer service as a major source of frustration.

So, what are the pros and cons of a digital-only offer for banks?

Banking is a highly regulated sector with a conservative corporate culture, therefore there are significant internal complications that must be handled. The danger of current businesses being cannibalized, as well as the necessity to develop a new, more flexible culture to support the incubation and growth of an in-house "start-up," are among them.

Six considerations to consider when starting a digital banking business:

1. Concentrate on the genuine worth.



To start a successful new firm, you need to know exactly what your value drivers are. While this may appear to be a no-brainer, we find that it is frequently ignored. The temptation is to imitate or reproduce established models instead. For example, mBank, Poland's first digital bank, has thrived by providing customers with unsecured personal loans and other straightforward products. It's a strategy that works in countries where credit cards aren't widely used, such as Poland and the Czech Republic, but it may not work in other areas.

Banks also have a tendency to believe that a single solution can be applied to a whole region. Regrettably, this strategy overlooks major value potential. For example, a thorough, country-by-country study of revenue per retail banking client indicates considerable product variations. When you break it down even further into different consumer groups or sub-segments, you'll see even more distinct characteristics that might help you formulate a company plan. In Taiwan, for example, 45 percent of banking clients are receptive to digital investing possibilities, compared to only 20 percent in Australia.

2. Establish a cooperation ecosystem

To establish a new digital banking service successfully, you must immediately acquire a critical mass of clients. E-commerce marketplaces and telecoms are two businesses with a big number of digital consumers that may assist in the process. E-commerce players may be beneficial partners since they allow banks to offer financing services for the site's current clients, including consumers and small and medium-sized businesses. There is an obvious benefit for the e-commerce player as well, because simple access to finance on an e-commerce site entices working capital-strapped, quickly developing small enterprises to continue selling on that site.

The benefit of a bank/e-commerce union is demonstrated by Alibaba's Ant Financial in China, which services small companies and has developed into a $20 billion industry in two years. Ant Financial has quickly risen to become one of China's largest lenders to small businesses, thanks to its straightforward loan application process. Although it is presently controlled by Alibaba, it began in 2007 as a joint venture between CCB and ICBC.

Another important factor that differs by country is the status of legislation (for example, the requirements for paper-based documents and forms) and the infrastructure that supports them (such as the availability of a universal national ID). Because of its favorable regulatory environment, China, for example, has been a major pioneer in digital banking.

3. Plan for flexibility, inventiveness, and speed.

Building a business utilizing a continuous iterative approach necessitates a different style of thinking than most banks are accustomed to. There are three places where a new way of working must be cultivated.

- Collaboration between teams. The core team creating the digital bank should be well-versed in not just the new technological architecture, but also the bank's design and branding, as well as the economics of its business model. This comprises both full-time and temporary employees in essential areas like compliance. The team can then progressively expand to include more members from the technical divisions. For example, Activobank, a digital bank located in Portugal, began with a management team of six to eight individuals during the creation of its digital business model, then grew to more than 30 throughout implementation (excluding line/operational positions).
- A work setting that resembles a garage. While a real garage isn't required, a physical place that fosters creative thinking and prototyping is. This entails open areas, plenty of whiteboards and worktables where people can gather and collaborate, as well as behaviors that encourage creativity, such as sprints. All of the people engaged in the creation of a digital bank—developers, IT security, compliance, risk assessment, and marketing professionals who understand the customer's needs—gather in one room for multiple live brainstorming sessions during a sprint. Instead of the usual long back and forth between departments, this

enables for rapid and efficient choices on the product's technical requirements. This procedure has the potential to significantly improve working results. Sprints can take as short as four weeks to get from whiteboard to functioning version of the product. Orange Bank, for example, spent around eight months from concept to introduction of version 1.0 of its digital product, stressing time to market and limiting modifications to its core banking system. They were also able to rapidly expand up, gaining up to 800,000 subscribers in the first eight months of existence. One important need and benefit of this method for banks is that it allows compliance and risk-assessment professionals to enter the room early and act as enablers and issue solvers, rather than gatekeepers who are frequently brought in after plans are well underway or completed.

- A “control tower” crew in the center. Launching a digital bank is a balancing act, with many mini projects going at once, such as a new credit card, personnel choices, organizational structure development, and brand design. The control-tower team's role is to ensure that all of these projects are coordinated by swiftly deploying resources to appropriate teams or prioritizing efforts in order to meet deadlines. The team must try to identify bottlenecks—such as vendors that don't respond quickly enough to requests or IT not having adequate data storage capacity—and then either address them immediately or submit the issues to the CEO or the board of directors.

This team should consist of excellent project managers with large-scale project management expertise, a high degree of familiarity with agile development and sprints, a solid working knowledge of the broad picture, and a clear grasp of applicable regulatory concerns.

4. Conduct frequent tests to improve the customer experience.

A mix of traditional consumer research and comprehensive, real-time understanding of individual customers' behavior and pain points is necessary to start a successful new digital-banking business. This includes creating a constant stream of prototypes, starting with the Minimum Viable Product (MVP) and on through iterations, to see what would improve the customer experience across all touchpoints. This sort of “real-world” testing is critical for discovering what consumers actually value, not just what they pretend to value. It also leads to a decrease of up to 80% in errors and omissions.

For example, one company approached the establishment of a digital-banking business aimed towards emerging-markets millennials with the idea that allowing consumers to sign in with their social-media accounts would be important. Customer interviews and many prototype versions (100 to 200 screens for structured consumer research and feedback loops) indicated that this was not the case. On the contrary, any relationship between their financial and social networks causes substantial security and privacy worries among urban and educated millennials. Instead of using social media to log in, the team decided to incorporate visual security indicators into the client onboarding process.

5. Establish a two-speed IT operational paradigm.

Two different yet integrated IT systems are required to implement the test-and-learn approach and short release cycles that are so critical for launching and operating a competitive digital bank: a traditional, slower, secure, and stable transaction-focused legacy back end and a rapid, flexible, customer-centric front end.

Small, product teams (often less than 10 people) should design the consumer front end utilizing an agile, sprint-based development strategy. These customer-facing aspects' software release cycles should be modular and intended for rapid deployment, with a focus on a minimum viable solution that will grow over time.

A mix of customized and out-of-the-box features can be utilized to shorten the time it takes to create the two-pronged system. One innovative digital player combines established front-end functionality, such as peer-to-peer payments, with new features that customers want but don't have much access to, such as personal-finance modules that let them to track their spending and create savings goals.

A variable-cost approach, such as cloud-based systems or data-storage solutions, should be explored to the degree that the existing IT architecture and legal environment allow it. A number of solution providers are moving into emerging regions to provide cost-effective alternatives to high-capex data center expenditures. Adopting a cloud-based solution enables a new digital player to grow up its cost structure in tandem with income, allowing for a speedier breakeven point. It also provides more flexibility, especially if the architecture is built with open APIs to allow collaboration with potential financial-technology partners who currently work in the cloud.

6. Be inventive with your marketing

Because digital-only banks lack the same customer-acquisition options as traditional banks with branch networks, marketing is a significant investment, accounting for up to 30 percent of overall operating expenses. This is true even for legacy banks that develop digital start-ups, since if the new organizations are to succeed, they must clearly separate their brand and value proposition from the parent business. In comparison to incumbent banks, digital-only banks will most likely target a younger, more digitally aware consumer. For example, AirBank, which debuted in the Czech Republic without the support of a traditional bank, positioned itself as the “first bank you would like,” promising that all client interactions would be jargon-free, and all costs would be clearly explained in a single document.

Banks must build word-of-mouth recommendations and feedback through social media to successfully express such specific selling features. This means pursuing clients in a far more focused manner than banks are accustomed to, both in terms of understanding how to optimize value based on regional disparities.

A campaign run by China's popular messaging app Tencent's WeChat over the Chinese New Year vacation in 2014 is one especially innovative marketing example. To advertise its WeChat Payment service, which allows for peer-to-peer transfers and electronic bill payment, the business released an app that allows users to send a certain amount of money to a set number of friends, with the money being distributed at random by the app. Recipients had to sign up for a WeChat account in order to redeem and see how much money they had been paid. WeChat's virtual envelopes became popular because they added a sense of anticipation to the New Year's custom of delivering money presents in red envelopes. In only two days, the firm managed to link 200 million current and new customers' bank cards to their accounts, an achievement that took Alibaba's Alipay eight years to achieve.

Asset Management

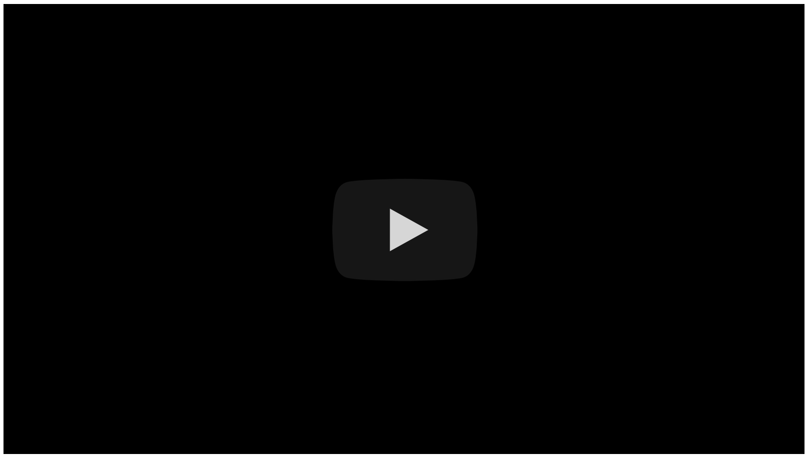
- Students will be able to provide a basic explanation of the benefits of asset management
- Students will be able to describe essential properties of DAMPS

In recent years, the asset management sector has witnessed a lot of technology innovation and upheaval. The emergence of so-called robo-advisers, who utilize sophisticated algorithms to create financial advice and portfolio allocations for their customers with little or no human interaction, is one example of these advancements. Market leader in robo-advisory Betterment, Acorns (a micro-investing and robo-advisor platform), and Vanguard (an “incumbent” in the asset management business) are all examples of digital asset management innovators.

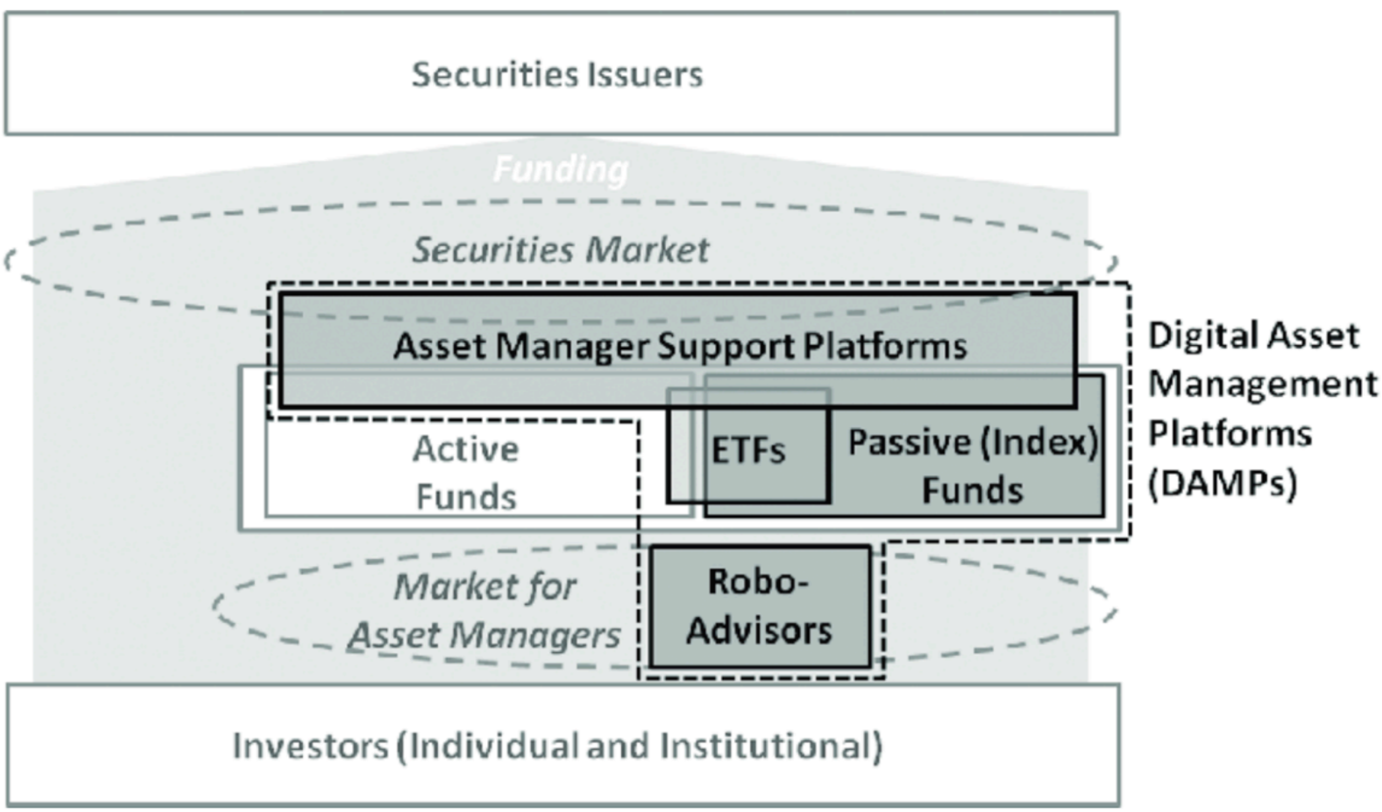
Between 2010 and the first quarter of 2020, the retail investment subsector of this FinTech vertical raised 5 billion dollars. The amount raised each year increased dramatically in 2018, with almost 1.4 billion dollars raised in that year alone, nearly double the amount raised the year before. For at least three reasons, the coming year will be crucial for digital asset management.

- First, retail solutions in the digital asset management sector, such as those offered by the businesses mentioned above, are gaining traction, not just among digital natives (millennials and Gen-Z), but also among older, richer consumers who have come to embrace these goods.
- Second, during the COVID-19 pandemic, stay-at-home measures make utilizing a digital asset management solution more appealing, since customers are limited in their ability to meet in-person with their financial advisers and are more inclined to use online/digital solutions.
- Finally, robo-advisory start-ups like as Betterment and Acorns have never experienced a down market, which is a contrast to these favorable aspects. They often invest in broad-based ETFs, so their performance should not lag the market too much but proving to their customers and investors that they can weather a downturn will be a problem.

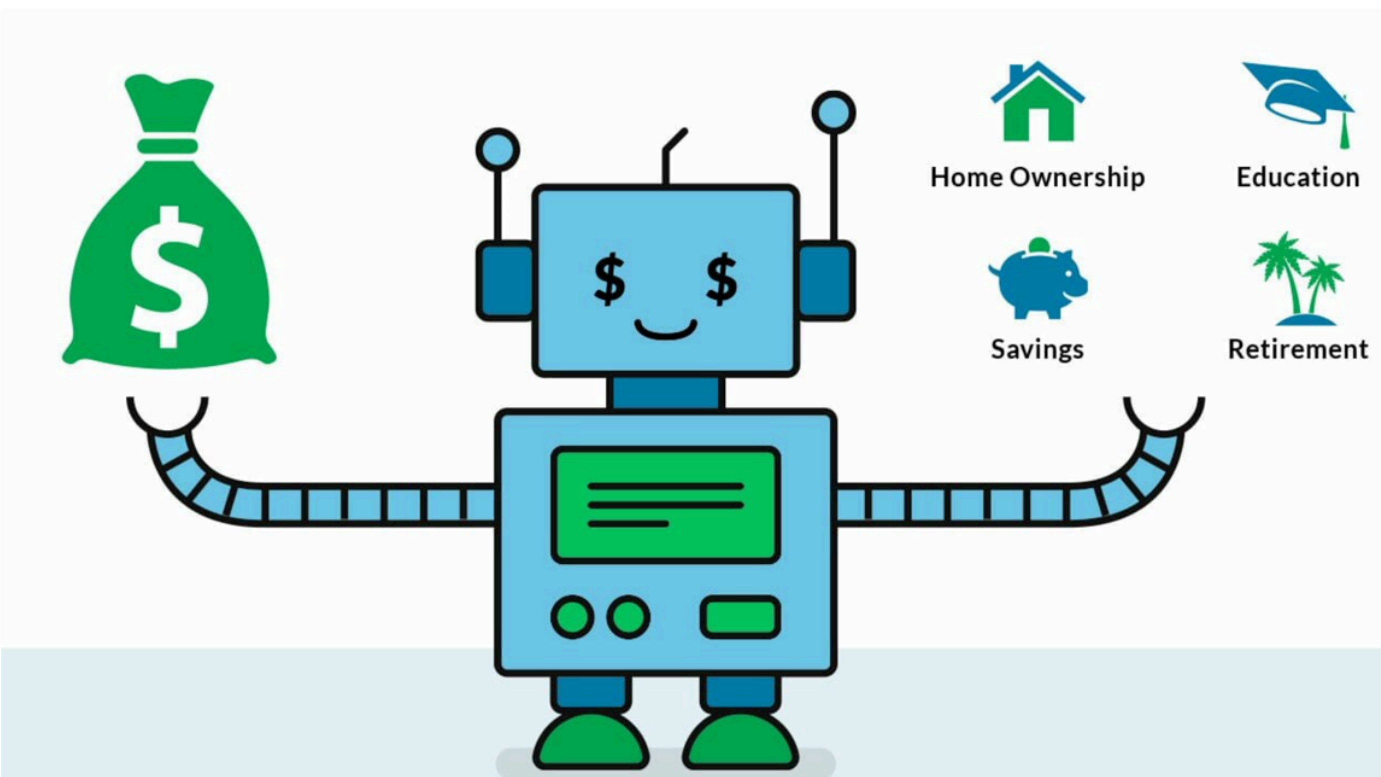
Asset management is a perfect fit for the digital platform economy in many ways, because asset managers do not operate as matchmakers between securities issuers and investors, but rather work as intermediaries between them. Until recently, however, this similarity to the platform economy model was obscured by an asset manager rivalry paradigm that is effectively the platform model's polar opposite. Rather from serving as low-cost, transparent conduits between investors and the securities market, managers have been charged hefty fees to cover significant costs—particularly highly-paid labor—incurred in an attempt to outperform their rivals.



The increasing computational complexity of asset management hasn't necessarily posed a threat to this long-standing economic model. However, in terms of the quantity of money involved, the growth of what we call "digital asset management platforms" has progressively overtaken this computerized reproduction of the conventional high-cost fund management approach (DAMPs). DAMPs fundamentally reorganize the securities market, providing substantial cost savings for investors and drastically upsetting conventional business models, rather than utilizing technology to gain a competitive edge inside the securities industry.



DAMP is divided into four categories. The oldest are index (passive) funds, which are relatively simple algorithmic funds that essentially “buy the market” to reduce investor expenses. These funds take use of securities markets' strong pre-existing information arbitrage efficiency to substantially improve market functional efficiency. ETFs (Exchange Traded Funds) are a type of index fund that improves functional efficiency by reorganizing the fund management process as a two-sided market platform. “Asset manager support platforms” sit between fund managers and the securities market, blurring the line between managers and the market. These services include portfolio risk management, trading optimization and execution, and regulatory compliance support for both active and passive managers. In contrast to index funds, they utilize advanced data-driven analytics to improve the securities market's fundamental valuation efficiency and functional efficiency. Finally, the most recent DAMPs are "robo-advisors," which are essentially ETF distributors. Robo-advisors are the most similar to digital platforms outside of finance in that they concurrently improve all elements of market efficiency in the retail market for fund managers—rather than the securities market itself—in a complimentary way.



As stated earlier, robo-advising is the newest field of DAMP development. This is aimed at the retail market for fund management solutions, rather than the securities market. Robo-advisors, at their most basic level, are online price comparison tools that direct customers to the lowest-cost investment products, which are generally ETFs. Robo-advisors, on the other hand, frequently create custom product portfolios depending on a client's condition and preferences. The industry is currently tiny, nevertheless, it has been increasing at a rate of 70–100% per year. Virtual "front offices" for large vertically integrated DAMP ecosystems are rapidly becoming robo-advisors.

Capital Markets

Objectives:

- Students will be able to provide a basic overview of capital markets
- Students will be able to describe how FinTechs are affecting the capital markets value chain

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On the institutional side, traders who used to make buy and sell decisions on trading desks are now up against algorithms that can complete deals in a fraction of the time. Rather, behind-the-scenes data analytics businesses that serve capital markets have some of the most promising development prospects and overlap with some of the most intriguing FinTech horizontals discussed below.

The bank has always been at the heart of the financial world. FinTech businesses have been able to grab market share in conventional banking efforts such as payments, lending, investments, and financial planning because to a shifting regulatory climate and the proliferation of data. In their primary industries, companies with no asset base or traditional banking infrastructure have made considerable gains. Banks have responded to these issues in a number of ways, with varying degrees of success, but only those who actively collaborate with and assist FinTech entrepreneurs have earned a competitive advantage.

Connectivity, alternative models, and acceptability, along with seismic shifts in businesses' capacity to access finance and a global regulatory architecture that prioritizes risk mitigation, have created an ideal environment for disruptors to collaborate with capital market players. In the capital markets, FinTech is driven by the requirements of incumbent market players who want to learn more about new technology and business models. Recent financing and innovation have been focused on building a better and more robust financial center, with implications for trading, markets, and security servicing – the full capital markets value chain.

In the search for a way to build a robust infrastructure, many of these FinTech disruptors are modeling entirely new conceptions of investing, trading, clearing, settlement, and custody; some of these players have created technology solutions in other verticals or parts of financial services and are bringing their solutions to the capital markets. Others are developing more efficient point solutions to address major pain spots in market infrastructure, post-trade, and access to finance.

As already said, FinTech refers to the influence of a new generation of cloud and mobile technology on financial services procedures. FinTech is linked to open service designs that use application programming interfaces (APIs) as well as internet-based business models. FinTech was once viewed as a threat to major, established financial institutions. Now that these firms and authorities are taking steps to improve client safety, we're on the verge of a new phase, in which financial stalwarts become platforms, hosting and collaborating with newer, smaller competitors. For exchanges, technology has been a source of structural transformation. The pace of change has accelerated in recent years as a confluence of regulatory, capital, and business model factors have disrupted the financial market ecosystem.

Funding for the subsector "Financial Research and Data" exhibited a dramatic increase in just a few years. For example, Kensho (launched in

2013) is a Massachusetts-based startup company that employs natural language processing (NLP) algorithms and Big Data Analytics to uncover hidden value for institutional investors. To this point, the company has managed to secure 67.5 million dollars. Some of Wall Street's biggest names, including Bank of America Merrill Lynch, Citigroup, JP Morgan Chase, Morgan Stanley, Wells Fargo, Standard & Poor's, have already invested in the startup. Another interesting business in this sector is PeerIQ, which specializes in risk analytics and pricing in the peer-to-peer lending market, as well as asset-backed securities issued by P2P lending firms. PeerIQ received 20.5 million dollars in seed funding from a group of venture capital firms and TransUnion.

The capital markets sector is still working hard to address a number of issues. Investment banks' returns on equity continue to underperform, due to persistently high structural expenses, stagnating revenues, and high capital charges. While efforts to change culture and reestablish trust are underway, success in these areas will take time. A part explanation is that they are largely focused on implementing changes that have been imposed by authorities or are prompted by external threats. However, this has its own set of issues: the combination of complexity and constant pressure to meet regulatory deadlines is causing organizational fatigue, as well as leaving management with insufficient bandwidth to take a step back and look ahead in order to invest in initiatives that will improve return on equity. Simply put, the financial markets business model must change – and change soon. Evidence suggests that the sector has only been marginally successful in delivering transformation and controlling its cost base, necessitating a fresh approach. As a result, innovation has become a must. However, organic progression toward a new model would be extremely challenging for most companies in the sector.

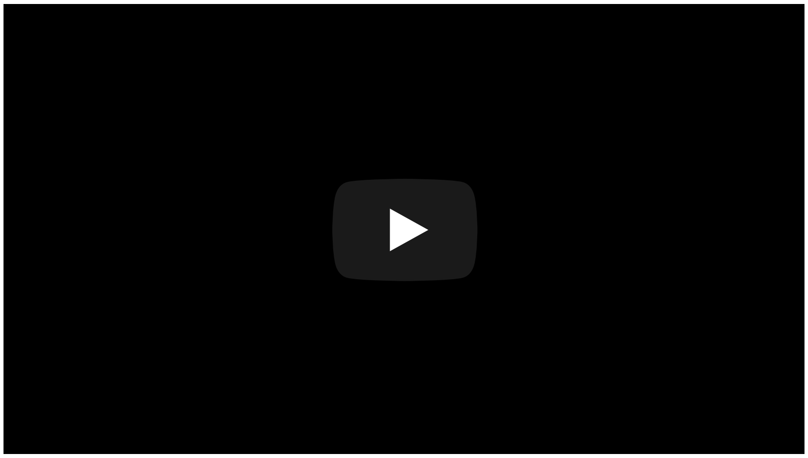
A new FinTech ecosystem is emerging that has the potential to address many of the issues that today's investment banks face. Even better, the nascent FinTech sector is well-funded, eager to assist, and fueled by a mix of seasoned industry veterans and young talent unconstrained by the traditional ways of doing things. The forecast of industry decentralization is a recurring subject in FinTech talks, with incumbent giants perceived as challenged by creative and nimble start-ups. According to economists, the "new era of FinTech is defined not by the financial goods or services supplied, but by who delivers them."

However, the development of DAMPs (as already discussed in previous chapters) has resulted in a typical digital platform contradiction of centralization via democratization in practice. On the one hand, ETFs and robo-advisors provide consumers with significantly lower fees, arguably leveling the playing field in favor of smaller investors. DAMPs, on the other hand, show noticeable rising returns, resulting in a winner-take-all concentration of platform provider market share. Indeed, BlackRock, Vanguard, and State Street now control a disproportionately significant share of the asset management. These are increasingly acting as vertical monopolies that internalize control of all DAMP segments, rather than just horizontal monopolies/oligopolies inside particular DAMP segments.

FinTechs are affecting the capital markets value chain from top to bottom. FinTech platforms that facilitate securities issuance in primary markets have targeted instruments that are inefficiently dispersed. A system that connects dealers, issuers, and investors in private placements, such as in Europe's medium-term note market, is one example. Investment-grade bonds and equity capital markets have similar ambitions. The goal is to improve intermediation while maintaining transparency and electronic audit trails in accordance with regulations (e.g., fair allocations). Another emphasis area is the automation of manual processes in primary market intelligence, with software that may, for example, automatically give matchmaking forecasts to assist bankers in identifying prospects with the best conversion potential.

It should come as no surprise that for all of FinTech's advantages, there are an equal volume of potential dangers. With new disruptive technology, there are always certain drawbacks, and the impacts are amplified in the worlds of investment banking and capital markets.

The acceptance of technology in institutional banks is a cultural problem. The South Korean government, for example, recognizes that FinTech is altering the character of financial services. However, the sector is heavily regulated, and the government is concerned about the long-term viability of their current banking infrastructure; without FinTech innovation, is there a new risk of technological complacency and ultimate obsolescence in comparison to other countries? South Korean financial institutions risk losing competitive advantage if they do not take efforts to improve their financial technology, enabling their financial environment to become non-competitive on the world stage.



In the new world, there are new risk exposures. FinTech can open the virtual vault door to criminal activity, whereas banks and market suppliers believe themselves impregnable fortresses. Hackers' talents and resources grow in tandem with technological advancements. Today, we can observe how attackers have become more organized, even reaching the level of entire governments. We are only now beginning to understand the true magnitude of the threat to the sector, as well as whether or not the threats will stalemate FinTech's wider adoption.

When it comes to regulatory concerns, the risks to FinTech may be even greater and more urgent than the possibility for security breaches. In general, technology aids in the circumvention of conventional national borders. National borders may appear less significant in the case of FinTech, but regulatory authorities on both sides are keeping a careful eye on foreign sovereignty concerns, legal jurisdiction, consumer data protection, and taxes. While risk management is presently seen as a barrier to FinTech enterprises by regulators, we anticipate to see a better degree of cooperation among banks, FinTech businesses, and regulatory authorities in the future.

Algorithmic Trading

Objectives:

- Students will be able to provide a basic overview of algorithmic trading
- Students will be able to explain the advantages and disadvantages of algorithmic trading

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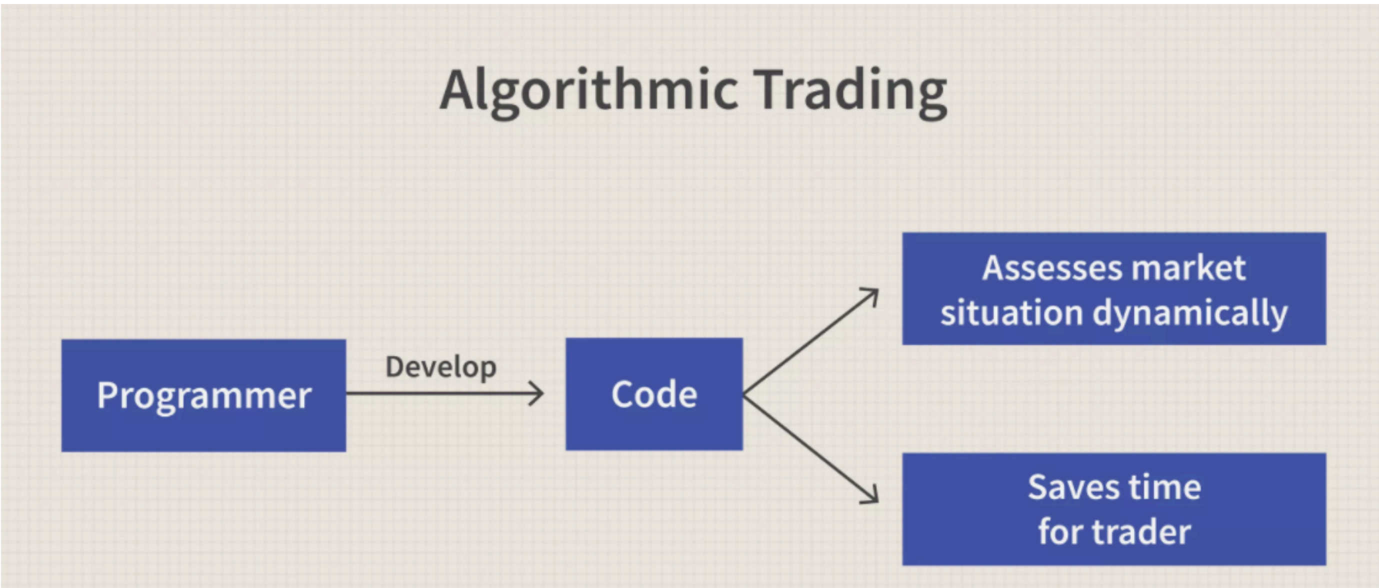
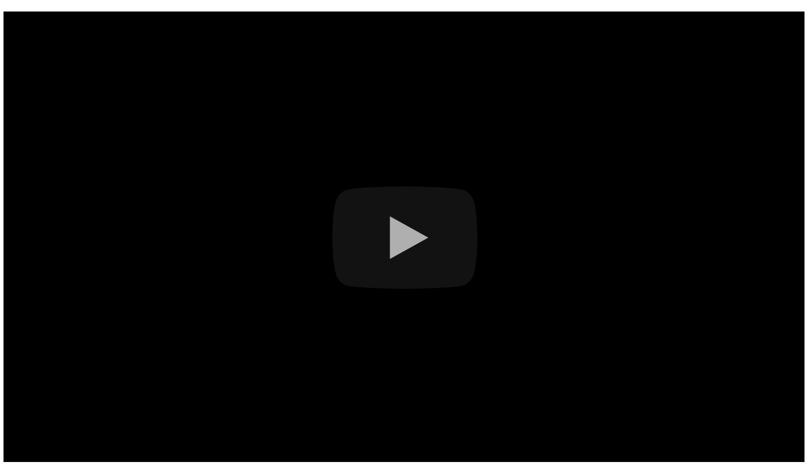


Market players reveal their purchasing and selling interests before dealing with one another in an organized market system made up of many trading venues, such as regulated markets and multilateral trading facilities (MTF) — formerly known as alternative trading systems (ATS). The continuous double auction is the most common mechanism for price discovery used by equity markets, in which participants place market or limit orders for their trading offer and demand, and incoming orders are continuously matched against an order book made up of two queues of passive limit orders – one for buy (bid) and one for sell (ask) – sorted by price and time priori. To put it another way, the outstanding limit orders provide the liquidity required for aggressive, liquidity-taking market orders to be executed. The trading process, as well as the evolution of collateral prices, may be understood as a result of the interaction between order flow and persistent order book liquidity from this perspective.

Because executing a large order is more difficult due to increased market effect and signaling risk, order size is crucial in trading. Slice big orders and spread their execution across time to reduce the related implicit transaction costs is one method to address these challenges. Algorithmic Trading (AT) refers to automated programs that implement order execution strategies. Regulators emphasize the automated and computer-based decision process – with no human interaction – of deciding individual order trading factors such as time, pricing, and quantity setting, as well as the management of orders once they are submitted – in their definitions of AT. To be clear, AT does not include any system that merely deals with automated order routing or order confirmation, i.e., no real selection of trading parameters.

Payment services, online loans, data analytics, and automated investing, according to Informilo.com, were the fastest-growing areas for big data in finance in 2015. The structure of capital markets has been altered by investing automation and other new associated technologies. The development of both co-location services and rapid trading platforms has reduced market-wide latency, allowing additional sophisticated investors to access the market. Algorithmic traders (AT) trade assets on the world's major stock exchanges utilizing high-speed and high-performance computing, complex tools, and algorithms. Both academics and politicians are paying close attention to these shifts and the behavior of market players. Many studies examine AT's position in capital markets, as well as its trading methods and market quality implications. Similarly, market regulators have raised reservations about ATs' increasing engagement and the expense of monitoring their action.

Depending on whether or not market players employ algorithms to make trading choices without human participation, overall trading activity may be divided into two categories: algorithmic trading (AT) and non-algorithmic trading activity (NAT) (ESMA 2014). High-frequency trading (HFT) and AT are defined differently in the European Markets in Financial Instruments Directive (MiFID II), with the former being a subset of the latter. AT is described as “trading in financial instruments in which a computer algorithm selects individual parameters of orders, such as whether to make an order or how to handle the order after it is submitted, with minimal or no human interaction.” This does not include any system that is only for the purpose of routing orders to trading scenes, processing orders without assessing any trading factors, order confirmation, or post-trade processing of performed transactions. Furthermore, the MiFID II defines HFT as "an algorithmic trading technique characterized by an infrastructure that minimizes network and other types of latencies using specific facilities such as co-location, proximity hosting, or high-speed direct electronic access, as well as by a system determination of order initiation, generation, and execution for trades or orders without human intervention."



Although there is no universal definition of high-frequency trading (HFT), several regulatory agencies and academics have attempted to identify two main characteristics and trading strategies of HFT: I the automation of the trading process, and (ii) the high speed of transactions and order submission (invalidation). Due to the fact that only a few datasets (such as E-Mini Data and NASDAQ Data) allow for the detection of HFT activity, most research use proxies to detect HFT activity and emphasize the implications of HFT on capital markets.

Algorithmic trading advantages

1. Quick and autonomous: The algorithm reacts to changes faster than any human, regardless of how long he spends trading. After the algorithm is built, it will be able to function without interference.

2. Removes the emotional component of trading: The most shocking exchange disappointments occur when traders allow their emotions to show signs of improvement. The frenzy and begin selling even in the most unfavorable conditions or become too hungry and opt to sell at a reasonable stock price.

Algorithmic trading disadvantages

1. Requires constant research: There is no system that will continue to benefit its constituents till the end of time. Since the goal is to maintain a strong portfolio, a significant amount of time needs to be devoted to learning about this subject, perfecting the code, and enhancing the trading approach.

2. Requires discipline: What was stated earlier regarding using it to eliminate the emotional aspects of trading may be true if an individual can totally trust his/her calculations and not interfere with them. This can be problematic, especially during expanded drawdowns. Techniques that have proven beneficial in back testing are frequently obliterated by human intervention.

Insurance

Objectives:

- Students will be able to provide a basic overview of the insurance sector
- Students will be able to describe the value of a more complete digitization of the insurance industry

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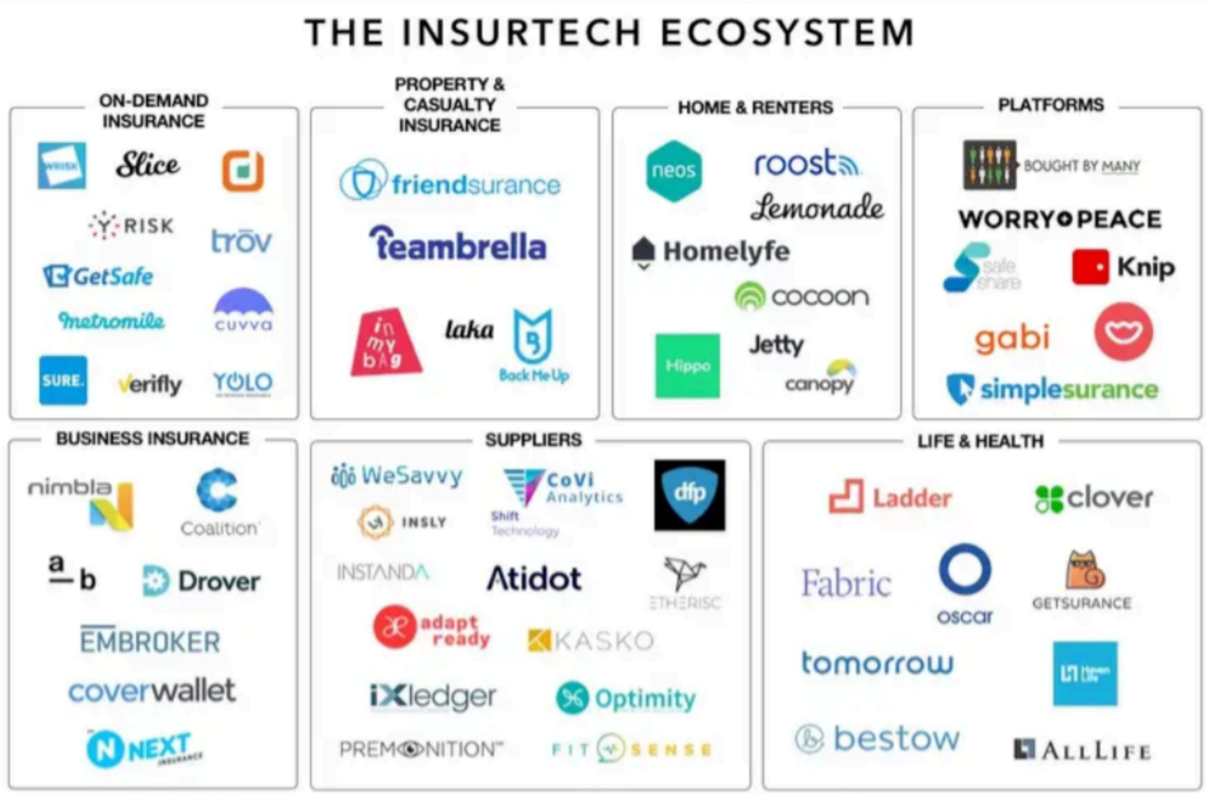
Insurance's intangible nature indicates that it should be completely digitizable, yet this promise is rarely realized today. The procedures that underpin the supply of insurance are based on the exchange of data and money. The insurance firm and its customer exchange information regarding the risks to be covered and the terms of their insurance, which finally provide the legal basis for the parties' rights and duties, which include premium payment and claims. Despite the promise for digitalization, paper-based procedures still dominate the insurance industry globally. This is due to the fact that insurance is a relatively new sector, with some of the major insurers going back to the nineteenth century. Much younger and smaller insurers also have legacy systems and procedures that are wary of significant change and, for the most part, focus on serving current markets. It's impossible to picture today's insurance industry without computers, although their widespread use coexists alongside manual paper-based operations. Because of the high cost, the maximum amount of an insurance policy that can be supplied sustainably is limited, and consumers must be patient. Other reasons for the limited digitalization of insurance include legal restrictions, cybersecurity and data protection, and acceptance by specific client groups who may suffer digital exclusion if paper-based procedures are replaced too rapidly by digital ones.

The FinTech Revolution in Insurance

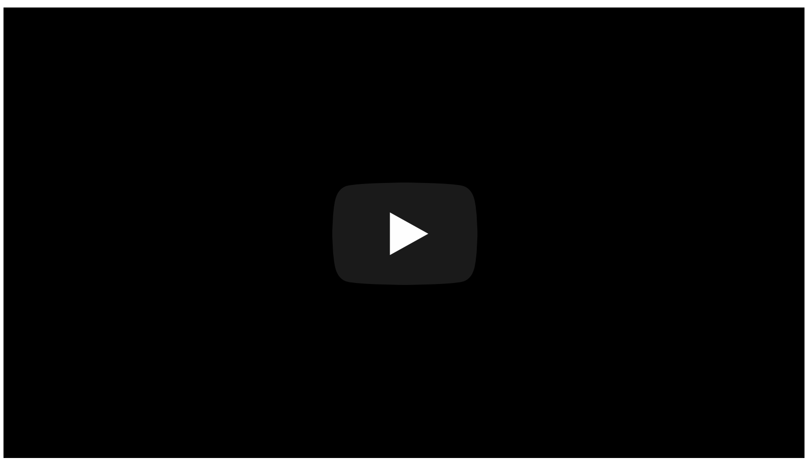
Although the insurance business has embraced technological innovation in diverse ways, its influence on how it interacts with clients has been minimal. Leading reinsurance companies, for example, used artificial intelligence techniques available at the time to build computerized underwriting systems for life and disability insurance in the early 1990s. Highly specialized underwriters assess the insurability of people with bad medical histories or specific hobbies, and their scarcity has been a limiting issue for insurance's greater reach, particularly in developing countries. “Expert System” software allowed for the codification of these specialists' heuristics into decision-making algorithms that could then be deployed at the point of sale, bypassing the traditional exchange of special questionnaires for special conditions and allowing for the immediate insurance of large sums of money well before the internet's omnipresence. This technology was critical to the proliferation of improved annuity products, but it was only available in a few sectors. Several insurance-related enterprises sought to bring insurance advice and distribution online during the late 1990s dot-com bubble. From there, few internet comparison sites arose, but few companies lasted when funding became scarce.

link

The term "InsurTech" refers to a current movement aimed at revolutionizing the insurance industry. Furthermore, InsurTech refers to the use of technology innovation to the insurance business in the FinTech Ecosystem. Insurance businesses of all types are depending on technology and complex data analytics more than ever before. Since the Great Recession, insurance, like other financial services industries, has seen a flood of technological and data-driven advances. Many of these ideas make use of linked gadgets. The idea is that insurance companies will have much more access to real-time and near-continuous data about our health, driving habits, and other behaviors thanks to data obtained from wearable sensors (e.g., an Apple Watch) or from the dashboard of an automobile (Progressive and State Farm offer these dongles that attach under the car's dashboard, referred to as an onboard diagnostic port). As a result, insurance firms may be able to dynamically reprice policies: safer and healthier behavior (e.g., working out frequently or driving within the speed limit) may result in lower life insurance or auto insurance rates. Insurance companies do not require the usage of these trackers; instead, they provide the customer with the choice to do so. We believe this has the potential to worsen the adverse selection problem that currently exists in insurance markets. Insiders in the insurance business have informed us that these impacts are washed out by pooling and aggregating data.



Statements like “The insurance sector is on the verge of massive technology-driven transformation” and “insurance will change more in the next 5 years than in the past 100 years” began to gain traction in 2015 — that year's InsurTech startup financing totaled 2.65 billion dollars. More than 1,300 worldwide startups are working on insurance-related technological solutions. The wider “FinTech” trend, to which The Economist dedicated a special article in May 2015, has fueled this excitement. FinTech is expected to not only challenge established company structures, but also to help people get access to financial services. Even before the COVID-19 epidemic, InsurTech was thought to be the most important FinTech vertical to monitor in the future. InsurTech startups got over 6.7 billion dollars in investment in 2019, according to Venture Scanner data, up from 3.87 billion dollars the year before and 3.7 billion dollars in 2017. The epidemic appears to have given this already promising field even greater impetus. The health and medical insurance segment of the InsurTech vertical is likely to see increased user metrics, revenue, and provide plenty of ammunition for capital raises and strong exits when the economy recovers, thanks to the growing use of telemedicine (which often integrates payments and insurance claims through none other than InsurTech solutions). There is also less of a need for car insurance because many people are on “stay-at-home” orders all over the world. For example, Pay-per-mile (or pay-per-distance) vehicle insurance is offered by several InsurTech firms, such as Metromile. In the short term, stay-at-home orders and local quarantines may make these items more appealing to the general public. It's likely that, if accepted, the improved customer experience provided by these InsurTech businesses will make it simpler to keep conventional carrier converts. Increased demand for these new and innovative automobile InsurTech companies will result in favorable numbers being reported by the P&C corner of the InsurTech vertical, likely paving the way for more investment opportunities and successful exits upon economic recovery, as we saw with health and medical insurance.



The value of a more complete digitalization of the insurance industry varies depending on the situation. Despite increased customer centricity commitments, insurers in mature markets can continue to service their traditional client groups in the same way they have in the past. This covers the small sectors of society that insurers primarily service in underdeveloped nations, such as those with bank accounts, mailing addresses, and experience filling out forms. Their dissatisfaction with present insurance processes is modest, as is their desire to invest substantially in technology and risk the unpredictability of potential upheaval. Other client segments, on the other hand, will necessitate a different strategy. Millennials and proponents of the "Sharing Economy" are examples of such populations in industrialized economies. However, in developing countries, they encompass a far larger number of prospective consumers, including the poor and the vast majority of the population who had hitherto been underserved by insurance: (emerging) middle classes, non-poor rural people, and women.

Real Estate

Objectives:

- Students will be able to provide a basic overview of the real estate as both an asset and enterprise
- Students will be able to describe the impacts on real estate through Fintech

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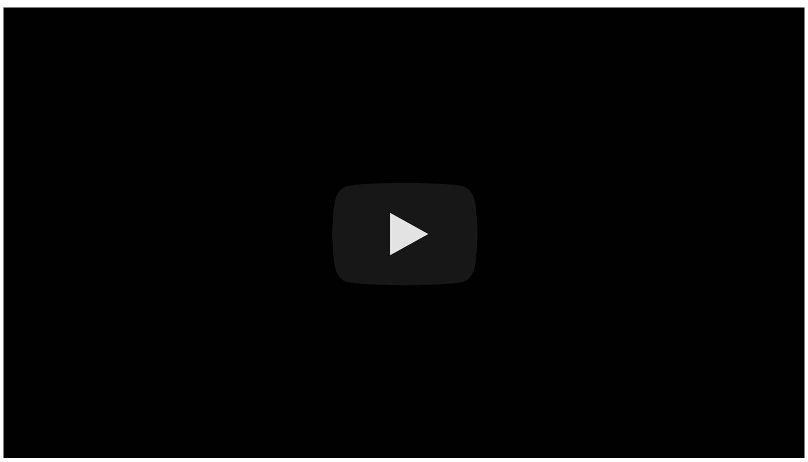
Real estate, as an asset and as an enterprise, is not immune to the fourth industrial revolution's advances. PropTech, as it's been called, refers to the digital revolution that's now going place in the real estate sector. PropTech's origins may be traced back to three distinct movements or impacts. Fintech, Smart Building Technologies, and the Shared Economy were the three topics discussed.

Smart Buildings are technology-based systems that make it easier to manage and operate real estate assets. Single property units or entire cities might be considered assets. The platforms might merely give information on the performance of a building or an urban center, or they could directly enable or regulate building services. This industry supports the management of real estate assets, properties, and facilities. We define PropTech as technology that aids in the design and/or construction of buildings or infrastructure (often referred to as ConTech).



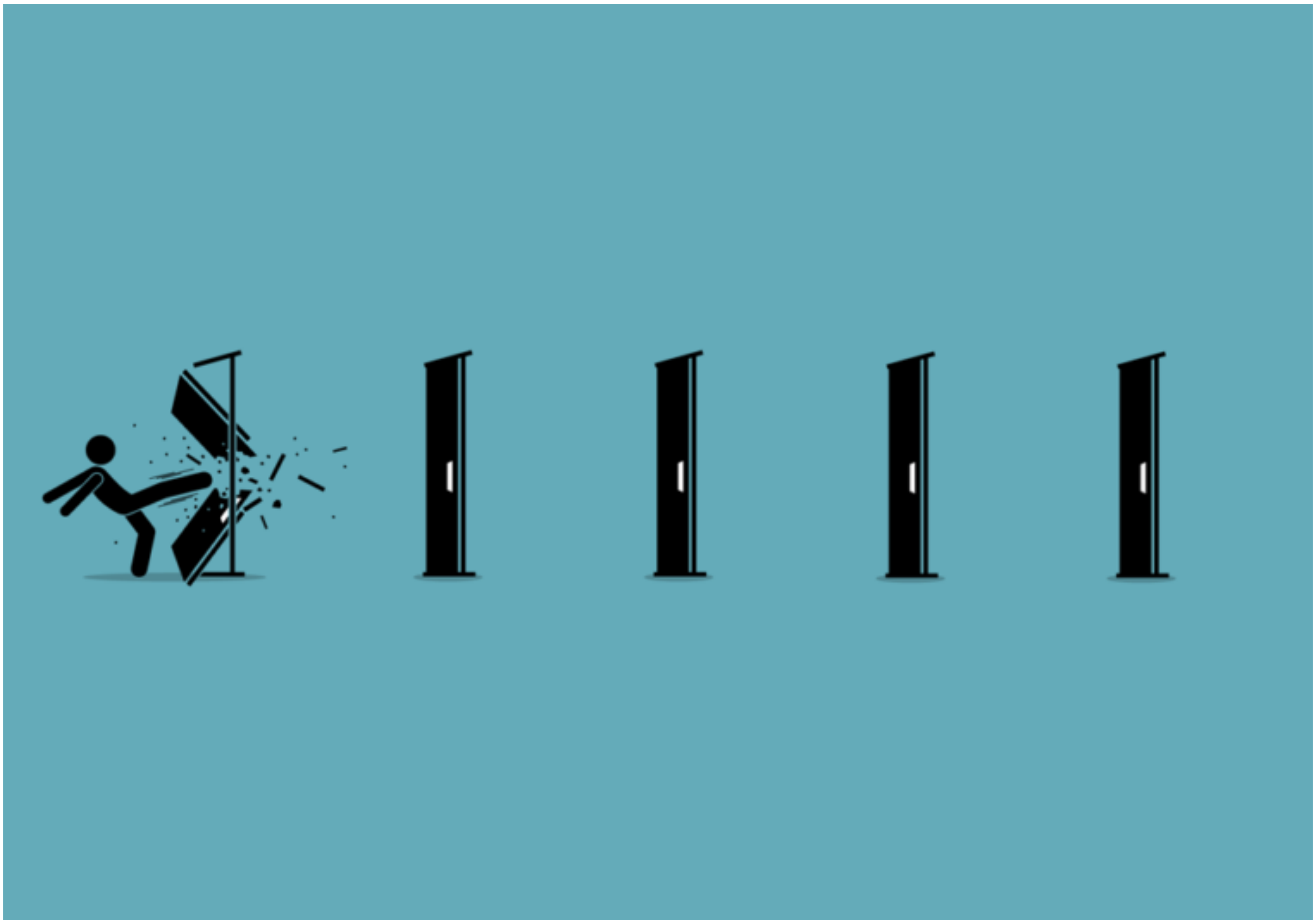
Technology-based systems that allow the trade of real estate asset ownership are referred to as real estate FinTech. Buildings, shares or cash, debt or equity are all examples of assets. The platforms may merely give information to potential buyers and sellers, or they could help enable or effect asset ownership or lease transactions with a (negative or positive) capital value.

The Shared Economy refers to technology-based platforms that make real estate assets more accessible. Land or structures, including offices, stores, storage, housing, and other property kinds, can be used as assets. The platforms may merely give information to potential space buyers and sellers, or they may arrange, or effect rent- or fee-based transactions more directly.

Real estate isn't renowned for being a change-resistant industry. The asset class's characteristics, which consists of vast, diverse assets exchanged in a mostly private market, may be a contributing factor. Homes may be too valuable a component of a private portfolio to take any chances with the process of trading, holding, or valuing them. It's also possible that there's an agency issue: the professional advisors who dominate the transaction process have a vested interest in preserving their income streams, so chartered surveyors, brokers, and lawyers might all be expected to resist tech-driven innovations that threaten their livelihoods.

Despite this, the real estate sector has gone through two significant technological shifts. Traditional advisers and a clear second wave of technology-based innovation are currently engaged in a struggle for market share. In the mid-1980s, the first wave (PropTech 1.0) occurred. It was all about data and processing power. Computing's creation in the 1930s and 1940s, as well as its subsequent 40 years of development, had little or no influence on real estate markets. The emergence of the personal computer in the late 1970s/early 1980s was a major catalyst for change. PropTech 2.0's exponential expansion began around 2008, when the series' growth began to pick up again. Exogenous technologies like cloud computing, mobile internet, lighter code, and broadband aided the late-stage 1.0 firms Rightmove, Zoopla, Trulia, and Zillow in achieving massive revenue growth. By 2010, the global financial crisis of 2007/8 had created a lack of trust in traditional procedures, and the advent of the smart phone and the multi-platform world, helped by open application programming interfaces (APIs), had permitted the invention of the ‘app.' This provided consumers with free access to a plethora of real estate data in real time. New company models such as Airbnb and WeWork (both of which rapidly became unicorns) emerged as the victors of this second wave of innovation, best equipped to provide better customer experience and provide an alternative to big institutions in the aftermath of the Great Recession.

Barriers for adoption



As suggested by the relevant literature, there are operational, regulatory and social barriers for the adoption of PropTech.

Operational obstacles are procedural adjustments that must be made in legacy real estate systems or platforms built by digital start-ups. They are as follows:

1. Integration of software processes: Any new system must work with current legacy procedures and software.
2. Standardized digital data: Before technology can offer efficiencies, it needs to be up to date and correct.
3. Critical mass: efficiencies can only be realized if a new system has gained widespread use. In a network, one legacy actor can reduce the entire process to analogue approaches.

4. Transition costs: Upscaling the current software, hardware, and labor force comes at a significant financial cost. Technology should not only be concerned with the adoption of a new system, but also with the problems in discharging the old.
5. Data security: it's critical to make sure that new systems can withstand a natural disaster or a cyber-attack.

Regulatory barriers are legal concerns that new technologies have ignored or that the industry must address in order to achieve effective technological adoption.

They are as follows:

1. Legal framework: any solution must not circumvent existing legislation, and it is necessary to guarantee that present regulation does not suffocate innovation.
2. Transparency in technology: Technology solutions must be open about their data sources and the logic behind their results.

Behavioral and emotional opposition to the acceptance of any new system are referred to as social barriers. They are as follows:

1. Lost revenue: new technologies that aim to improve process efficiency must do so at the expense of their intended users. A technology's long-term financial benefits must be well recognized.
2. Disintermediation risk: we need a clear knowledge of who wins and who loses when a new technology is adopted, as well as matched incentives for potential adopters.
3. Confidence in innovation: There is a lack of trust in innovation due to a lack of knowledge of new technological solutions that can, nevertheless, enhance the efficiency of corporate operations. Many private sector data partnerships are hampered by multinational social media companies' abuse of data and a legitimate fear of fueling

prospective data monopolists.

4. Collaborative attitude: real estate companies are hesitant or unable to share their data with the public.

Depending on the features specific to each real estate organization, these obstacles will manifest in various combinations and strengths. Many eager PropTech start-ups hoping to "disrupt" the sector will be able to do so only after a series of changes.

Credit Scores

Objectives:

- Students will be able to provide a basic overview of credit scores
- Students will be able to show an understanding of the usefulness of digital footprints for consumer financing

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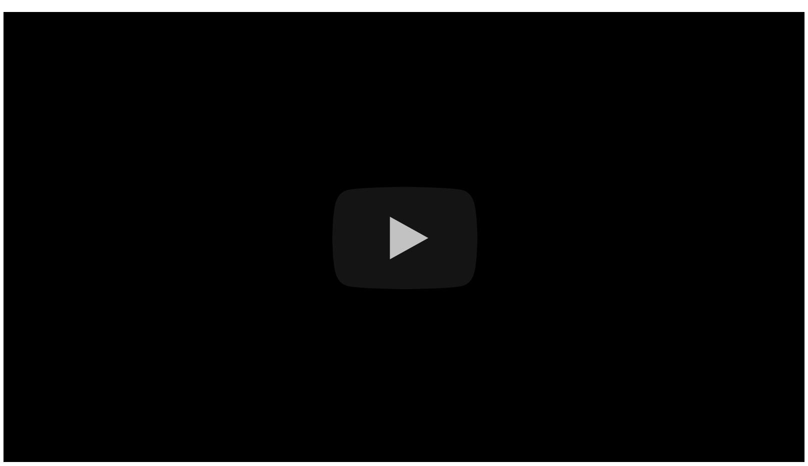
The development of the internet has left a trail of simple, easily available information on nearly every person on the planet. Even if no text about oneself is written, no financial information is uploaded, and no friendship or social network data is provided, the sheer act of visiting or registering on a webpage leaves significant information. In order to determine whether the digital footprint can be utilized to forecast customer payment behavior and defaults by supplementing information that is usually thought to be relevant for default prediction.

Understanding the usefulness of digital footprints for consumer financing is crucial. The greater capacity of financial intermediaries to obtain and process information important to borrowers' screening and monitoring is one of the main reasons for their existence. If digital footprints offer substantial information on anticipating defaults, FinTech businesses, with their superior capacity to access and analyze digital footprints, may pose a danger to financial intermediaries' information advantage, and hence pose a threat to financial intermediaries' business models.



Intro to Econometrics

Objectives:

- Students will be able to demonstrate a basic understanding of econometrics
- Students will be able to explain why econometrics is important to business analysis and other disciplines

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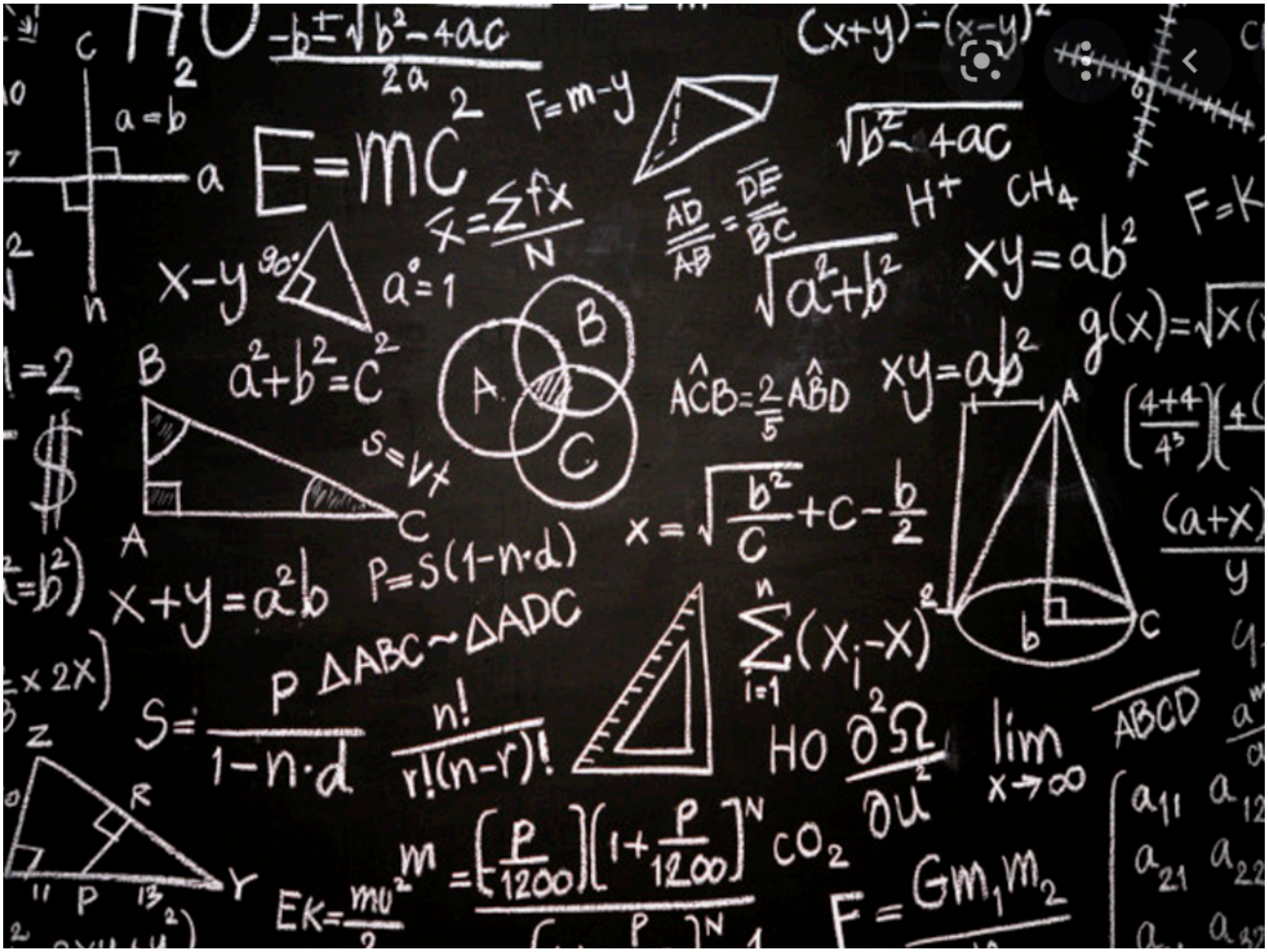
For economic measurement, econometrics is essential. Econometrics is significant, however, extends far beyond the field of economics. Econometrics is a set of research methods used in accounting, finance, marketing, and management, among other business disciplines. It is utilized by social scientists, particularly historians, political scientists, and sociologists. Econometrics is used in a variety of disciplines, including forestry and agricultural economics. Because economics is the cornerstone of business analysis and the fundamental social science, there is a wide range of interest in econometrics. As a result, economists' study techniques, which include the subject of econometrics, are beneficial to a wide range of people.



In the education of economists, econometrics is very important. You are learning to "think like an economist" as an economics student. Economic concepts like opportunity cost, scarcity, and comparative advantage are being taught to you. You're dealing with supply and demand economic models, macroeconomic behavior, and international commerce. You will get a greater understanding of the world in which we live as a result of this course; you will learn how markets function and how government policies impact the marketplace.

If economics is your major or minor subject of study, you'll have a lot of options after graduation. If you want to work in the business sector, you must be able to answer the question, "What can you do for me?" ‘‘I can think like an economist," said students in a typical economics class. While we may think such a statement is strong, it isn't particularly detailed, and it may not satisfy an employer who doesn't understand economics.

The issue is that there is a disconnect between what you learnt in economics class and what economists really do. Only a small percentage of economists make a career solely by researching economic theory, and those who do are often hired by universities. Most economists, whether they work in industry or for the government, or teach in universities, participate in some form of empirical economic analysis. They utilize economic data to assess economic connections, test economic hypotheses, and forecast economic consequences.

We need to describe the nature of econometrics at this point. It all starts with a hypothesis about how significant variables are connected to one another from your field of study—whether it's accounting, sociology, or economics. The mathematical notion of a function is used in economics to describe our beliefs about connections between economic variables. To express a connection between income and consumption, for example, we may write

CONSUMPTION = f(INCOME)

This states that the amount of consumption is a function of income, f().

The demand for a certain commodity, such as the Hyundai Accent, may be stated as follows:

Qd = f (P, Ps, Pc, INC)

which says that the quantity of Hyundai Accents demanded, Qd, is a function f (P, Ps, Pc, INC) of the price of Hyundai Accents P, the price of cars that are substitutes Ps, the price of items that are complements Pc (like gasoline), and the level of income INC.

This equation is a common economic model that defines how we view the interrelationships between economic variables. This sort of economic model directs our economic analysis. Knowing that particular economic variables are connected, or even the direction of the relationship, is insufficient for most economic decision or choice issues. Furthermore, we must comprehend the magnitudes involved. That is, we must be able to determine the magnitude of a change in one variable's impact on another.

The Econometric Model

Objectives:

- Students will be able to define what an econometric model is
- Students will be able to explain the variables involved with an econometric model

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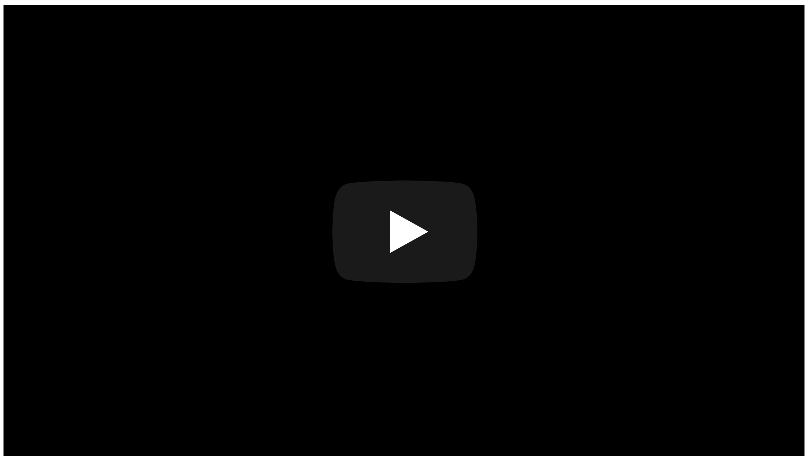


What exactly is an **econometric model**, and where did it originate? We must first recognize that economic relationships are not accurate in an econometric model. Economic theory does not pretend to be able to forecast the person or firm's unique conduct, but rather explains the average or systematic behavior of many individuals or companies. We realize that the actual number of Hyundais sold is the sum of this systematic element plus a random and unexpected component *e*, which we will term a random error, while examining vehicle sales. As a result, an econometric model of Hyundai Accent sales is developed.

$$\mathbf{Qd = f\,(P, Ps, Pc, INC) + e}$$

The random error *e* represents the inherent unpredictability in economic activity and accounts for numerous factors that impact sales that we have ignored from our simplified model.

We must additionally state something about the shape of the algebraic relationship among our economic variables to complete the econometric model definition. For example, quantity demanded was portrayed as a linear function of price in your first economics classes. We apply that assumption to the other variables as well, giving the demand relationship a systematic component.

$f(P, Ps, Pc, INC) = \beta 1 + \beta 2P + \beta 3Ps + \beta 4Pc + \beta 5INC + e$

The corresponding econometric model is

$Qd = \beta 1 + \beta 2P + \beta 3Ps + \beta 4Pc + \beta 5INC + e$

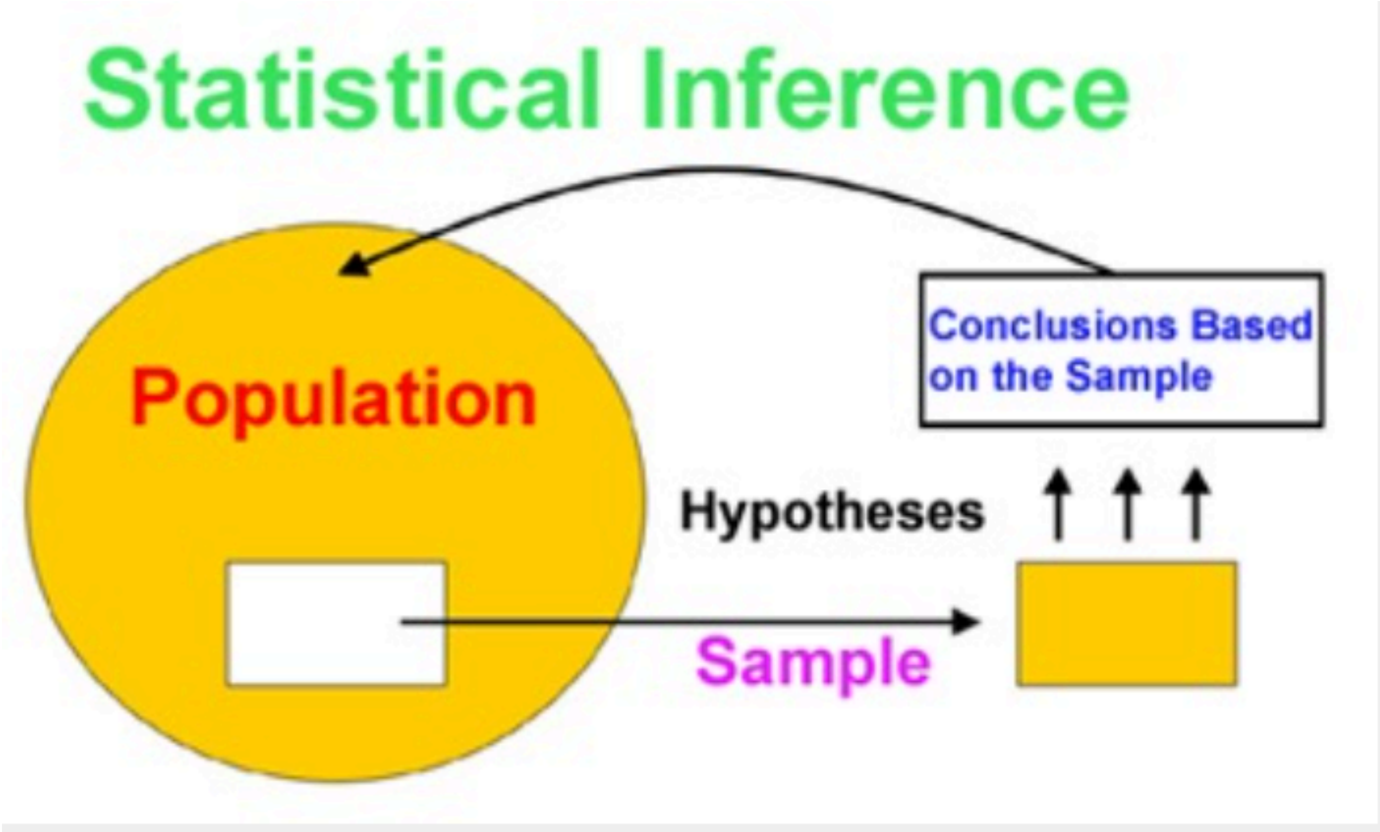
The coefficients β1, β2, ..., β5 are unknown model parameters that we estimate using economic data and an econometric method. The functional form represents a hypothesis regarding the variables' connection. One issue in every given situation is determining a functional form that is consistent with economic theory and facts.

There is a systematic portion and an unobservable random component in every econometric model, whether it be a demand equation, a supply equation, or a production function. The systematic element is the part we get from economic theory, and it contains a functional form assumption. The random component is a ‘‘noise" component that obfuscates our comprehension of the connection between variables and is represented by the random variable e.

For statistical inference, we employ the econometric model as a foundation. We draw conclusions about the actual world using an economic model and a sample of data, and we learn something in the process. Statistical inference may be done in a variety of methods.

- Using econometric techniques to estimate economic characteristics such as elasticities.
- Predicting economic results for the next 10 years, such as enrollment at two-year institutions in the United States.
- Putting economic ideas to the test, such as whether newspaper advertisements are more effective than shop displays in generating sales.

All of these elements of statistical inference are covered by econometrics.


Statistical Inference
Population
Conclusions Based
on the Sample
Hypotheses
Sample

The Roots of all Data

Objectives:

- Students will be able to differentiate between experimental data and non-experimental data

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We need data in order to make statistical inferences. What is the source of data? What kinds of real-world processes produce data? Economists and other social scientists operate in a complicated environment where data on variables is "observed" rather than "experimented" with. The work of learning about economic factors becomes much more complex as a result.

Experimental Data

Conducting or observing the outcome of an experiment is one approach to obtain knowledge about the unknown parameters of economic interactions. Controlled experiments are common in the physical sciences and agriculture. The values of important control variables are set by scientists, who then observe the results. We might plant comparable plots of land with a certain wheat type, then adjust the quantities of fertilizer and insecticide used to each plot, noting the bushels of wheat produced on each plot at the conclusion of the growing season. The experiment is repeated on N plots of land, yielding a sample of N observations. Controlled trials like these are uncommon in the business and social sciences. The values of the explanatory variables may be set at particular values in repeated trials of the experiment, which is a crucial feature of experimental data.

One business example comes from marketing research. Suppose we are interested in the monthly sales of a particular item at a grocery store. As an item is sold it is passed over a scanning unit to record the price and the amount that will appear on your bill. But at the same time, a data record is created, and at every point in time the price of the item and the prices of all its competitors are known. The prices and shopping environment are controlled by store management, so this ‘‘experiment’’ can be repeated a number of days or weeks using the same values of the ‘‘control’’ variables.

Non-Experimental Data

Survey data is an example of non-experimental data. The Louisiana State University Public Policy Research Lab (www.survey.lsu.edu/) conducts telephone and postal surveys for customers. Numbers are chosen at random and phoned in a telephone survey. Question responses are recorded and evaluated. Data on all variables is gathered concurrently in this context, and the results are neither fixed nor repeated. These are non-experimental data.

National governments conduct these kinds of surveys on a large basis. The U.S. Bureau of the Census, for example, conducts a monthly survey of roughly 50,000 homes called the Current Population Survey (CPS). For more than 50 years, the survey has been performed. "CPS statistics are utilized by government officials and lawmakers as vital indicators of our nation's economic position, as well as for planning and assessing numerous government initiatives," according to the CPS website. The press, students, intellectuals, and the general public all utilize them."

Economic Data Types

Objectives:

- Students will be able to differentiate between the various types of data

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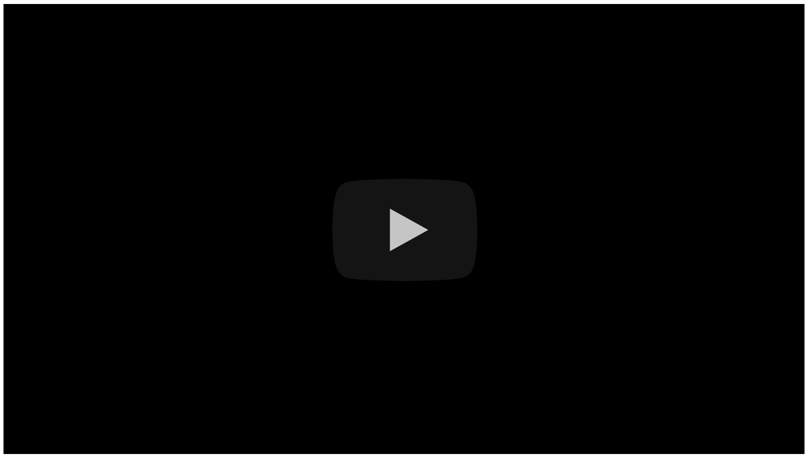
Economic information is available in a number of ‘‘flavors." Each is described and illustrated in this section. Be careful of the many data properties in each case, such as the following:

- Data may be gathered at several aggregate levels:
  - micro—information gathered on people, families, and businesses as economic decision-making units.
  - macro—information derived through aggregating or pooling data from people, households, or businesses at the local, state, or national level.
- Data may also be used to depict a flow or a stock:
  - flow—measures of a result through time, such as gasoline use in the fourth quarter of 2010.
  - stock—an outcome assessed at a certain moment in time, such as the amount of crude oil stored by Exxon in its United States storage tanks on November 1, 2010, or the asset worth of Wells Fargo Bank on July 1, 2009.
- Quantitative and qualitative data are both acceptable:
  - quantitative—numerical outcomes, such as prices or income, or some modification of them, such as real prices or per capita income.
  - qualitative—the results of a ‘‘either-or" scenario. A consumer, for example, may have made or not made a purchase of a specific item, or a person may be married or not.

Time Series Data

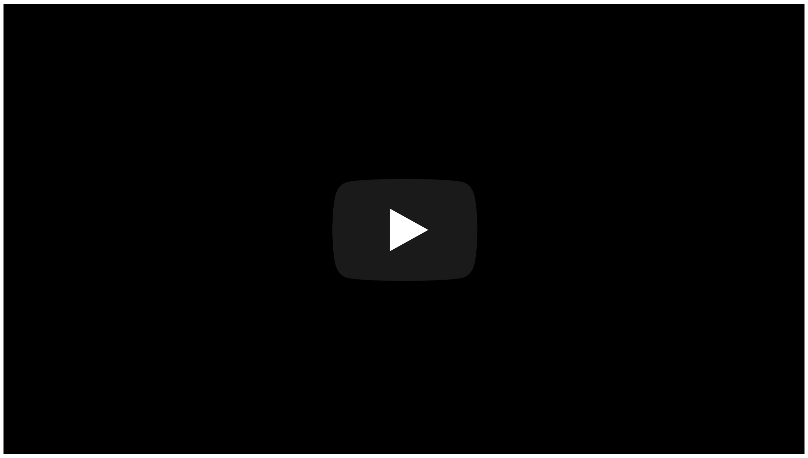


A time-series is a collection of data collected over a period of time. The annual price of wheat in the United States, for example, and the daily price of General Electric stock shares are two examples. Macroeconomic data is often published weekly, quarterly, or annually. Financial information, such as stock prices, can be recorded on a daily or even hourly basis. The main aspect of time-series data is that it records the same economic quantity at regular intervals.

The following table, for example, show the yearly real gross domestic product (GDP). We have the recorded value for each year. The data is annual, or annually, and has been ''deflated" to billions of actual 2018 USD.

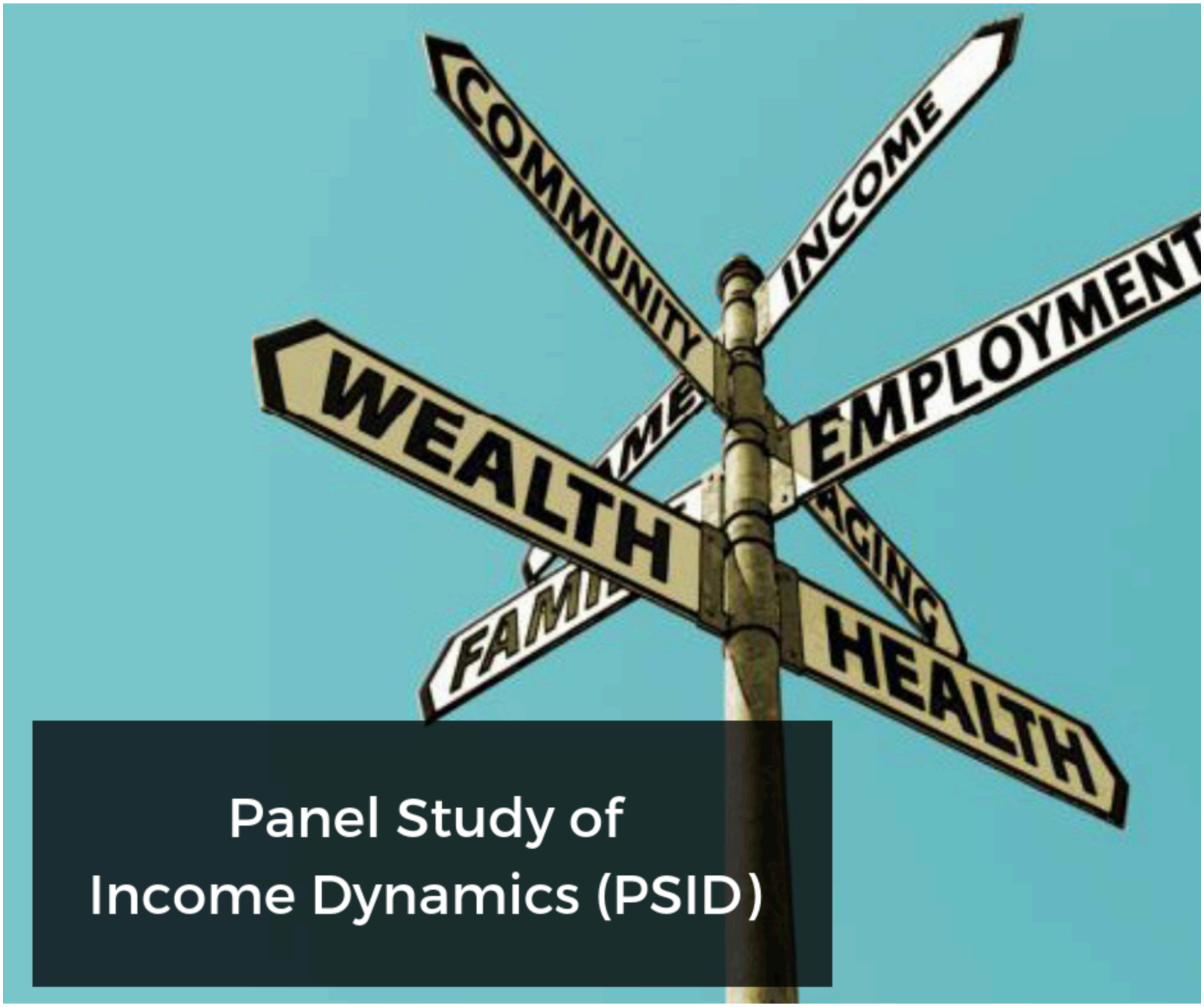
Year	Annual GDP (Billions of Real 2018 Dollars)
2012	11347.2
2013	11553.0
2014	11840.7
2015	12263.8
2016	12638.4
2017	12976.2
2018	13254.1
2019	13312.2
2020	13974.7

Panel (or Longitudinal) Data



In a given time period, a cross-section of data is collected across sample units. Income by county in California in 2019, for example, or high school graduation rates by state in 2018. Individual entities, such as businesses, people, families, governments, or nations, make up the “sample units.” The Current Population Survey, for example, publishes monthly findings of personal interviews on topics such as employment, unemployment, wages, educational attainment, and income.

Individual micro-units are seen and followed over time in a ‘‘panel” of data, also known as ‘‘longitudinal” data. The Panel Study of Income Dynamics (PSID), for example, presents itself as a "nationally representative longitudinal study of approximately 9000 US households." The PSID has been collecting data on economic, health, and social behavior of the same families and individuals since 1969." Other national panels exist, and many are listed at www.rfe.org under ‘‘Resources for Economists."



The fundamental feature of panel data is that we track each micro-unit, in this case a farm, across time. The amount of rice produced, the area planted, labor input, and fertilizer consumption are all listed here. A balanced panel has the same amount of time period observations for each micro-unit, which is the case here. The number of time series observations is usually modest in comparison to the number of micro-units, although this is not always the case. For some or all of the years 1950–2019, the Penn World Table offers purchasing power parity and national income accounts translated to international prices for 183 nations.

The following table shows data from three companies as an example. The data is based on yearly observations of these companies from 2015 to 2020.

Simple Linear Regression Model

Objectives:

- Students will be able to define what a linear regression model is
- Students will be able to describe the variables involved in a simple linear regression model
- Students will be able to provide the assumptions for a simple linear regression model
- Students will be able to explain how the error term impacts the simple linear regression model

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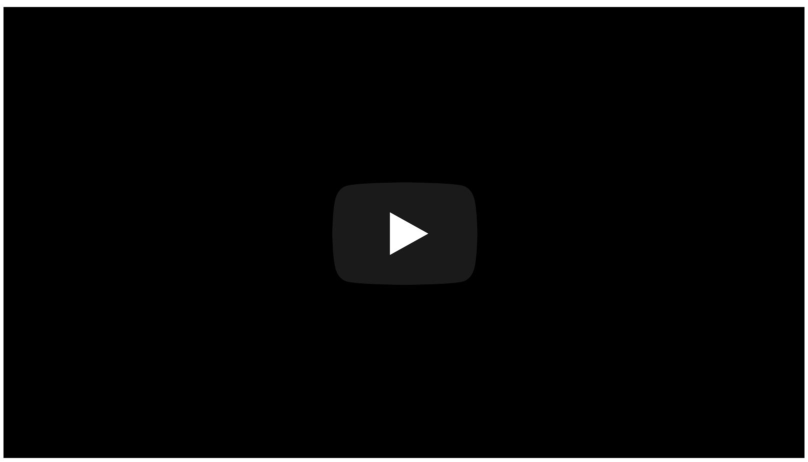


We will use a simple, yet important, economic example to develop the concepts of regression models. Assume we want to investigate the link between household income and food expenditures. Consider the "experiment" of picking households at random from a population. Households in a certain city, state, province, or nation may make up the population. Assume for the time being that we are only interested in households with a weekly income of $1,000. In this experiment, we randomly pick and interview a number of homes from this population. “How much did you spend per person on food last week?” we inquire.

Economic theory implies that average weekly per person household expenditure on food, represented mathematically by the conditional mean

$E(y|x) = \mu y|x$, is dependent on household income x in our food expenditure example. When we examine households with varying levels of income, we may anticipate the average food spending to vary.

To study the link between spending and income, we must first construct an economic model, followed by an econometric model, which will serve as the foundation for a quantitative or empirical economic analysis. Most economics textbooks show "consumption" or "expenditure" functions linking consumption to income as linear connections. The following depicts the mathematical formulation of our household food expenditure economic model.

$$E(y|x) = \mu y|x = \beta 1 + \beta 2x$$

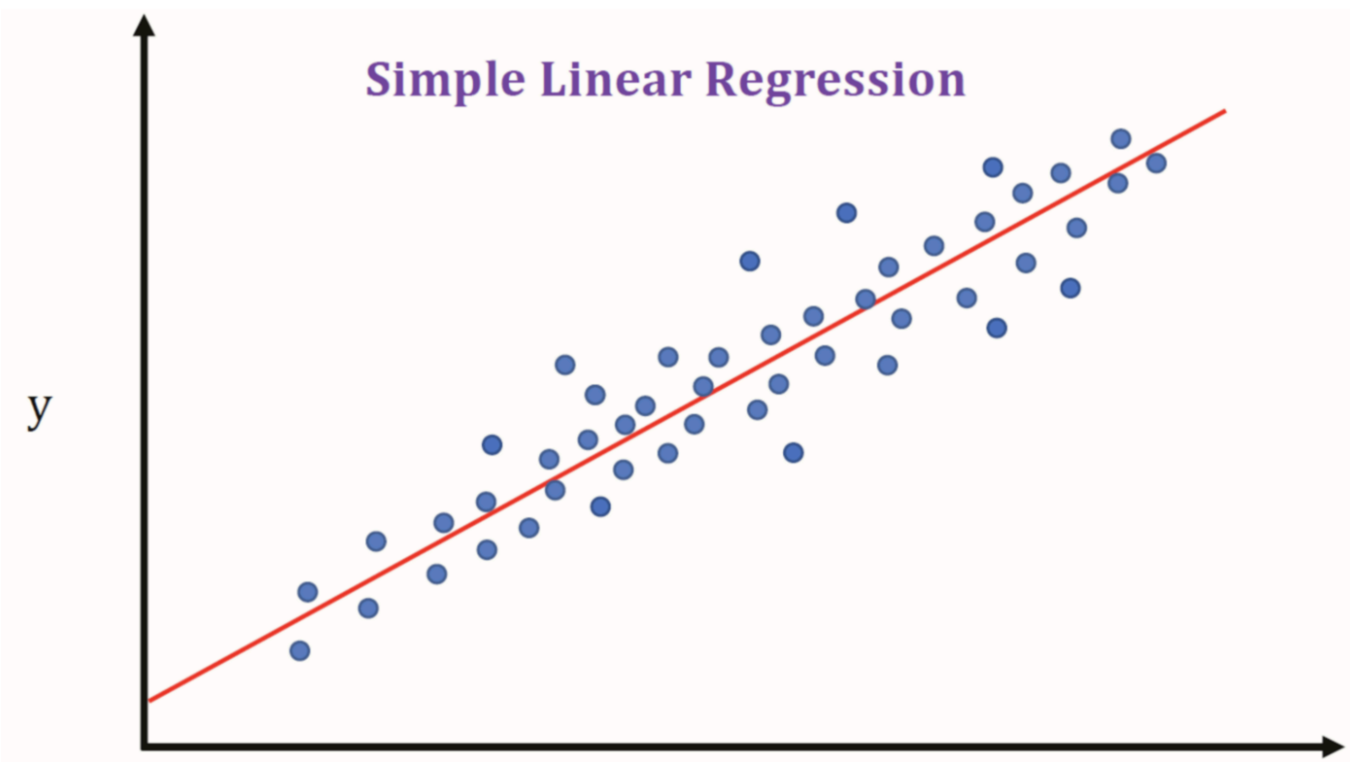
A basic regression function is the conditional mean $E(y|x)$. It is termed simple regression not because it's simple, but because the right-hand side of the equation only has one explanatory variable. The intercept and slope of the regression function are the unknown regression parameters $\beta 1$ and $\beta 2$, respectively.

The intercept $\beta 1$ reflects the mean per person weekly household expenditure on food by a household with no weekly income, x=$0, in our food expenditure example. If income is expressed in dollars, the slope $\beta 2$ reflects the change in $E(y|x)$ when weekly income is increased by $1. It is also known as the marginal willingness to spend on food.

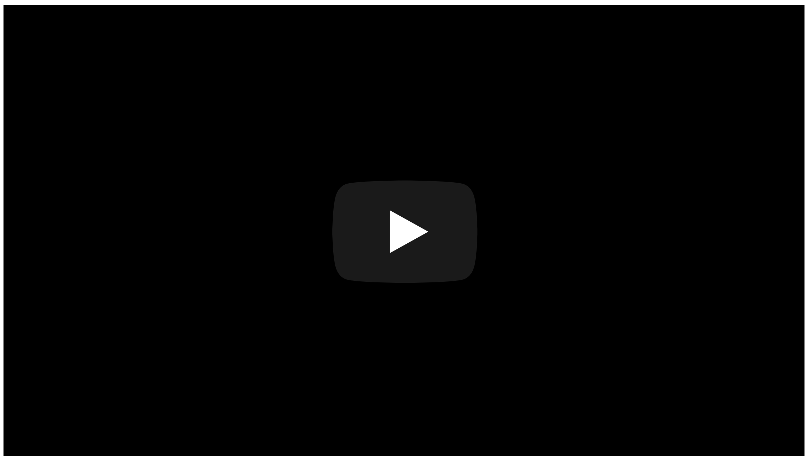
The link between weekly household income (x) and predicted household food spending, $E(y|x)$, is summarized in this economic model. The model's parameters, $\beta 1$ and $\beta 2$, are termed population parameters because they assist describe economic behavior in the population under consideration. To use data, we must first define an economic model that specifies how family income and expenditure data are collected and leads the econometric study.

Assumptions of the Simple Linear Regression Model

- The linear regression function returns the mean value of y for each value of x.
- The values of y are dispersed around their mean value for each value of x, using probability distributions with the same variance. The y sample values are entirely uncorrelated and have zero covariance, indicating that there is no linear relationship between them. This assumption can be strengthened by assuming that all of the y values are statistically independent.
- x is not a random variable; it must take at least two different values.
- For any value of x, the values of y are normally distributed about their mean.



The error term



The assumptions of the simple linear regression model are best described in terms of y, which is the dependent variable in the regression model in general. For statistical reasons, however, it is more helpful to define the assumptions in a different way. Any observation on the dependent variable y may be divided into two parts: a systematic component and a random component, according to regression analysis. $E(y|x) = \beta1 + \beta2x$ is the systematic component of y, which is not random because it represents a mathematical expectation. The difference between y and its conditional mean value $E(y|x)$ represents the random component of y. This is known as a random error term, and its definition is as follows:

$e = y - E(y|x) = y - \beta1 - \beta2x$

If we rearrange it we obtain the simple linear regression model

$y = \beta 1 + \beta 2x + e$

The random error term e and a component that fluctuates consistently with the independent variable x explain the dependent variable y.

Both the random error e and the dependent variable y are random variables, and the characteristics of one may be deduced from the properties of the other, as we've shown. However, there is one notable distinction between them: y is ‘‘observable," whereas e is ‘‘unobservable." If we knew the regression parameters β1 and β2, we could compute $e = y - (\beta 1 + \beta 2\ x)$ for every value of y. We may divide y into fixed and random components using the regression function $E(y) = \beta 1 + \beta 2x$. However, β1 and β2 are never known, thus calculating e is impossible.

What is the meaning of the error word e? All factors affecting y other than x are represented by the random error e. Individual observations y deviate from the mean value $E(y) = \beta 1 + \beta 2x$ due to these variables. What variables might cause a discrepancy between household spending per person y and its mean, E(y) in the food expenditure example?

- In this model, income serves as the sole explanatory variable. Other economic factors that influence food spending are "collected" in the error term. Because we aim to incorporate all of the key and relevant explanatory variables in any economic model, the error term e serves as a ‘‘storage bin" for unobservable and/or irrelevant factors impacting family food expenditures. As a result, it introduces noise that obscures the x-y connection.
- Because the linear functional form we imagined may only be an approximation to reality, the error term e captures any approximation mistake.
- Any components of random behavior that may be present in each person are captured by the error term. Knowing all of the factors that impact a family's food spending may not be enough to accurately anticipate spending. Human conduct that is unpredictable is also

included in e.

We need a method, or formula, to estimate b1 and b2, which informs us how to utilize the sample observations. There are a variety of rules to choose from, but the one we'll choose is based on the least squares idea. The sum of the squares of the vertical distances from each point to the line should be as minimal as feasible to match a line to the data values, according to this concept. To avoid huge positive distances from being negated by big negative distances, the distances are squared. This rule is arbitrary, but it works well, because it's just another way of describing a line that passes through the centre of the data.

More on linear regression: https://www.mit.edu/~6.s085/notes/lecture3.pdf

Multiple Linear Regression Model

Objectives:

- Students will be able to describe the components of a multiple linear regression model
- Students will be able to provide the assumptions applied when creating an econometric model from a multiple linear regression model and its error term

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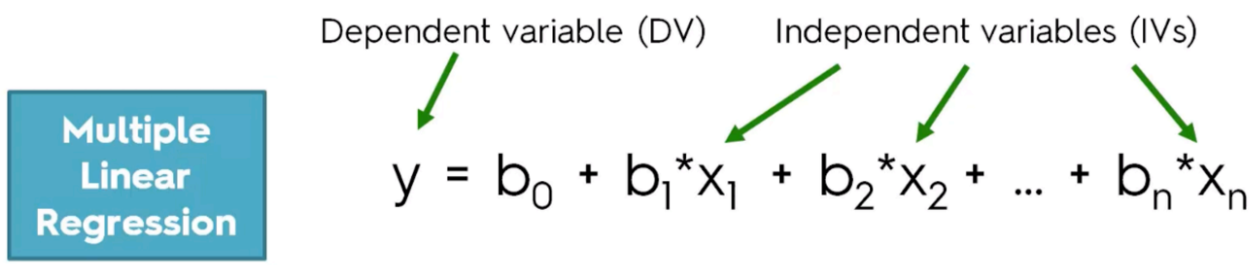
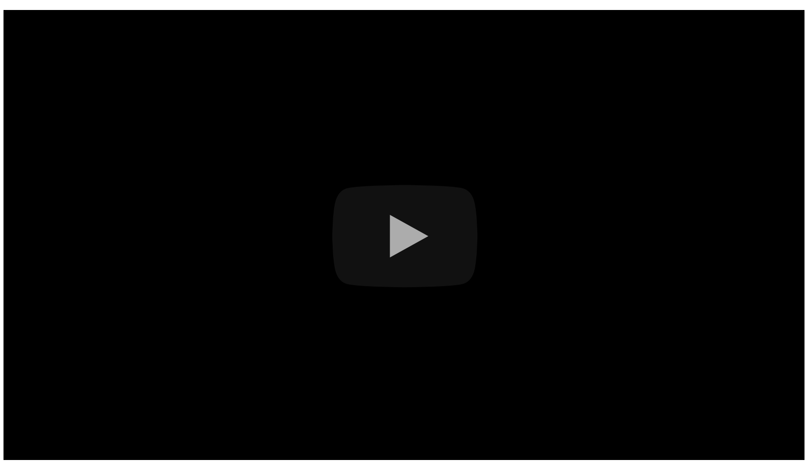
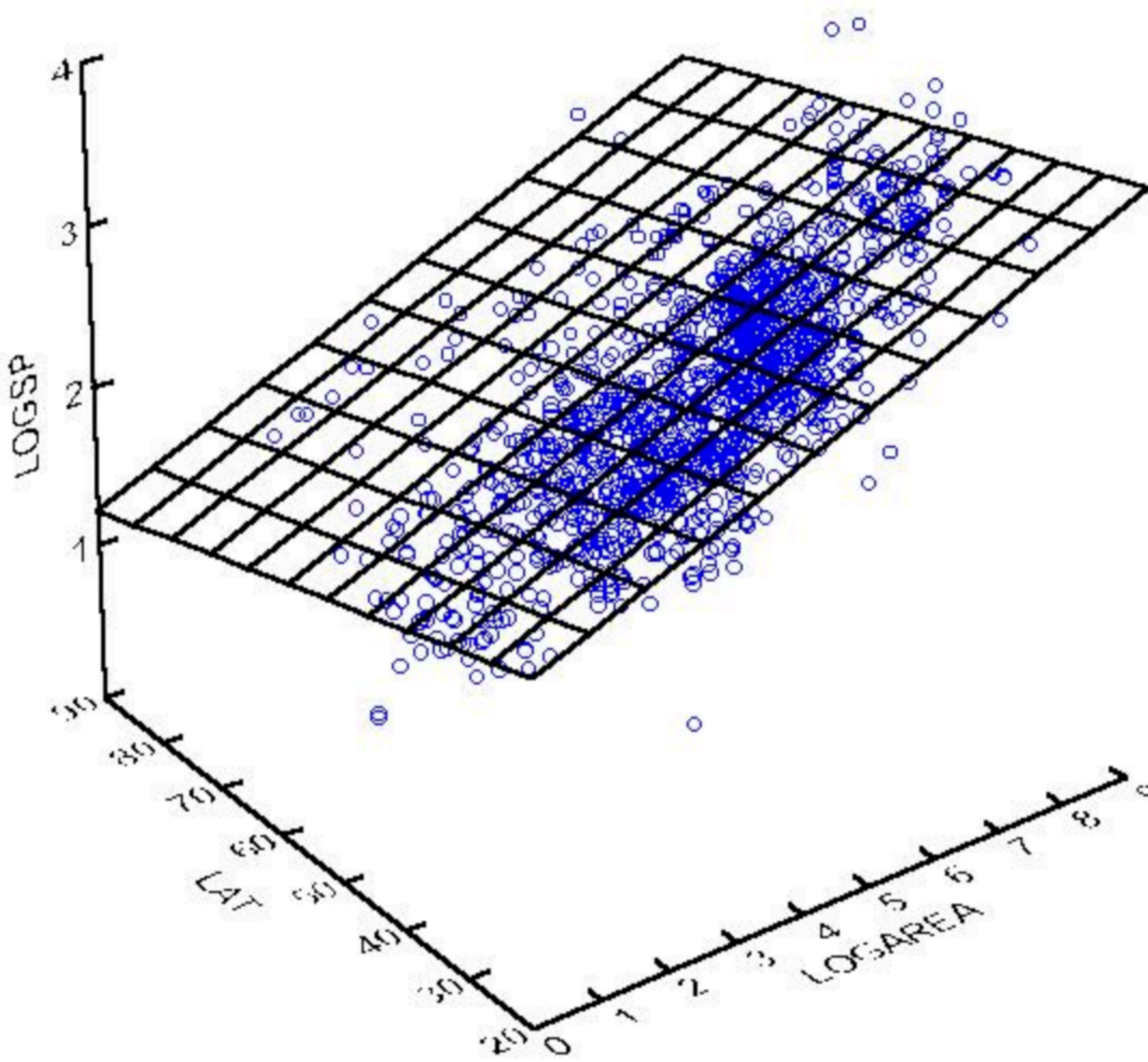




We'll create a business plan for a hamburger chain called Big Andy's Burger Barn. Big Andy's management makes important decisions such as pricing strategy for various items and how much to spend on advertising. Big Andy's Burger Barn sets different prices and spends different amounts on advertising in different cities to test the influence of alternative price structures and varied levels of advertising spending. How sales income fluctuates when advertising spend changes is of great importance to management. Is there a link between increased advertising spending and increased sales? Is the rise in sales adequate to warrant the higher advertising spend if that is the case? Pricing strategy is also of importance to management. Will lowering prices result in a rise or fall in sales revenue? Sales income will decline if a price reduction results to only a modest increase in quantity sold; sales revenue will rise if the price reduction leads to a big increase in quantity sold. This financial data is necessary for successful management.



Multiple Regression Model

The first stage is to create an economic model that includes one or more explanatory factors that affect sales revenue. We first hypothesized that sales income is proportional to both pricing and advertising spend. The financial model is

SALES = β1 + β2PRICE + β3ADVERT

where SALES represents monthly sales revenue in a given city, PRICE represents price in that city, and ADVERT is monthly advertising expenditure in that city. Both SALES and ADVERT are measured in terms of thousands of dollars. We concentrate on smaller cities with comparable populations because sales in larger cities will tend to be higher than sales in smaller ones.

β1, β2, and β3 illustrate how sales (SALES) are influenced by pricing (PRICE) and advertising (ADVERTISING) (ADVERT). The value of the dependent variable when each of the independent, explanatory variables is zero is known as the intercept parameter β1. However, in many situations, there is no obvious economic meaning for this characteristic. It is not possible to create a condition in which PRICE = ADVERT = 0 in this circumstance. We usually include an intercept in the model, even if it has no obvious economic interpretation, unless there are exceptional conditions. If you don't include it, you'll end up with a model that doesn't fit the data well and doesn't forecast properly. The model's other parameters quantify the change in the dependent variable's value in response to a unit change in an explanatory variable, with all other variables kept constant. β2 can have a positive or negative sign. If a price rise results in an increase in sales revenue, then β2 > 0, indicating that demand for the chain's products is price inelastic. A price-elastic demand, on the other hand, occurs when an increase in price results in a decrease in revenue, in which case β2 < 0. As a result, knowing the sign of β2 offers information about demand price elasticity. The magnitude of β2 refers to the amount of income that changes as a result of a price adjustment. The β3 parameter indicates how sales income changes in response to changes in advertising spending. The sign of β3 is expected to be good. That is, we anticipate an increase in advertising spending to result in an increase in sales income, unless the advertising is objectionable. With β3 < 1, a $1,000 increase in advertising spend will result in a revenue gain of less than $1,000. It will be larger if β3 > 1. As a result, understanding β3 is critical in terms of the chain's advertising policy.

We add a random error component, e = SALES - E(SALES), to account for the discrepancy between observed sales revenue and the expected value of sales revenue. Other than pricing and advertising revenue, this random error reflects all variables that cause sales income to deviate from its expected value. These influences might include the weather, rival activity, and changes in burger-buying behavior between cities, among others. The model is obtained by including the error term.

SALES = E(SALES) + e = β1 + β2PRICE + β3ADVERT + e

The addition of the error term and probability distribution assumptions transforms the economic model into an econometric model. The econometric model provides a framework for creating and evaluating estimators of unknown parameters, as well as a more accurate description of the connection between the variables.

Assumptions regarding the probability distribution of the random mistakes e must be made to complete the econometric model. We propose assumptions for e that are comparable to those for the basic regression model. These are

- A probability distribution with a zero mean exists for each random mistake. Some mistakes will be positive, while others will be negative; they will average out to zero over a large number of observations.
- Each random mistake has a σ2 variance probability distribution. The variance σ2 is an unknown quantity that measures the statistical model's uncertainty. It is the same for each observation, thus there is no difference in model uncertainty across observations, and it is unrelated to any economic variable. Homoskedastic errors are those that have this characteristic.
- There is no correlation between the two random mistakes relating to any two distinct observations. The magnitude of one observation's mistake has no influence on the magnitude of another observation's error. As a result, any two mistakes are unrelated.
- We'll also suppose that the random mistakes e have normal probability distributions on occasion.

We make two assumptions about the explanatory factors in addition to the previous assumptions about the error term (and hence about the dependent variable). The explanatory factors are not random variables, for starters. As a result, we're presuming that we already know the values of the explanatory variables before we see the values of the dependent variable. The second premise is that none of the explanatory variables are precise linear functions of the others. This is the same as presuming there are no duplicated variables.

Analysis: Technical, Fundamental & Sentiment

Objectives:

- Students will be able to differentiate the differences amongst technical analysis, fundamental analysis and sentiment analysis.
- Students will be able to describe the technical indicators associated with the technical analysis.
- Students will be able to discuss the importance of the LOB (limit order book).
- Students will be able to explain what tools are used for functional analysis.
- Students will be able to explain how sentiment analysis is used for predicting stock prices.

Technical Analysis

Technical analysis is a tool, or method, used to predict the probable future price movement of a security – such as a stock or currency pair – based on market data.

The theory behind the validity of technical analysis is the notion that the collective actions – buying and selling – of all the participants in the market accurately reflect all relevant information pertaining to a traded security, and therefore, continually assign a fair market value to the security.

Technical traders believe that current or past price action in the market is the most reliable indicator of future price action.

Technical analysis is not only used by technical traders. Many fundamental traders use fundamental analysis to determine whether to buy into a market, but having made that decision, then use technical analysis to pinpoint good, low-risk buy entry price levels.

Technical traders analyze price charts to attempt to predict price movement. The two primary variables for technical analysis are the time frames considered and the particular technical indicators that a trader chooses to utilize.

The technical analysis time frames shown on charts range from one-minute to monthly, or even yearly, time spans. Popular time frames that technical analysts most frequently examine include:

- 5-minute chart
- 15-minute chart
- Hourly chart
- 4-hour chart
- Daily chart

The time frame a trader selects to study is typically determined by that individual trader's personal trading style. Intra-day traders, traders who open and close trading positions within a single trading day, favor analyzing price movement on shorter time frame charts, such as the 5-minute or 15-minute charts. Long-term traders who hold market positions overnight and for long periods of time are more inclined to analyze markets using hourly, 4-hour, daily, or even weekly charts.

Price movement that occurs within a 15-minute time span may be very significant for an intra-day trader who is looking for an opportunity to realize a profit from price fluctuations occurring during one trading day. However, that same price movement viewed on a daily or weekly chart may not be particularly significant or indicative for long-term trading purposes.

It's simple to illustrate this by viewing the same price action on different time frame charts. The following daily chart for silver shows price trading within the same range, from roughly $16 to $18.50, that it's been in for the past several months. A long-term silver investor might be inclined to look to buy silver based on the fact that the price is fairly near the low of that range.

However, the same price action viewed on an hourly chart (below) shows a steady downtrend that has accelerated somewhat just within the past several hours. A silver investor interested only in making an intra-day trade would likely shy away from buying the precious metal based on the hourly chart price action.

Technical Indicators - Moving Averages

In addition to studying candlestick formations, technical traders can draw from a virtually endless supply of technical indicators to assist them in making trading decisions.

Moving averages are probably the single most widely-used technical indicator. Many trading strategies utilize one or more moving averages. A simple moving average trading strategy might be something like, “Buy as long as price remains above the 50-period exponential moving average (EMA); Sell as long as price remains below the 50 EMA”.

Moving average crossovers are another frequently employed technical indicator. A crossover trading strategy might be to buy when the 10-period moving average crosses above the 50-period moving average.

The higher a moving average number is, the more significant price movement in relation to it is considered. For example, price crossing above or below a 100- or 200-period moving average is usually considered much more significant than price moving above or below a 5-period moving average.

Technical Indicators - Pivots and Fibonacci Numbers

Daily pivot point indicators, which usually also identify several support and resistance levels in addition to the pivot point, are used by many traders to identify price levels for entering or closing out trades. Pivot point levels often mark significant support or resistance levels or the levels where trading is contained within a range. If trading soars (or plummets) through the daily pivot and all the associated support or resistance levels, this is interpreted by many traders as “breakout” trading that will shift market prices substantially higher or lower, in the direction of the breakout.

Daily pivot points and their corresponding support and resistance levels are calculated using the previous trading day’s high, low, opening and closing prices. I’d show you the calculation, but there’s really no need, as pivot point levels are widely published each trading day and there are pivot point indicators you can just load on a chart that do the calculations for you and reveal pivot levels. Most pivot point indicators show the daily pivot point along with three support levels below the pivot point and three price resistance levels above it.

Technical Indicators - Momentum Indicators

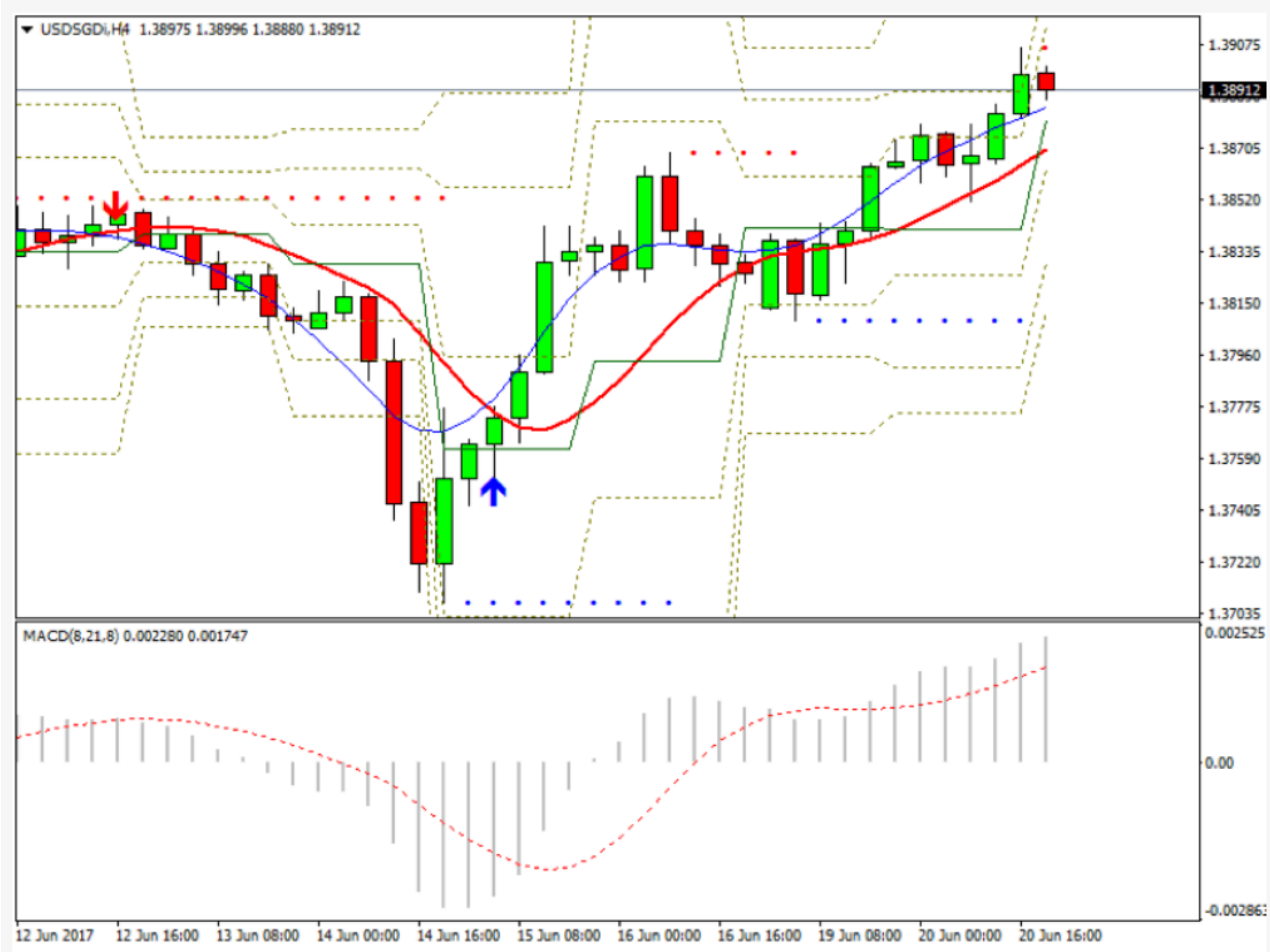
Moving averages and most other technical indicators are primarily focused on determining likely market direction, up or down.

There is another class of technical indicators, however, whose main purpose is not so much to determine market *direction* as to determine market *strength*. These indicators include such popular tools as the Stochastic Oscillator, the Relative Strength Index (RSI), the Moving Average Convergence-Divergence (MACD) indicator, and the Average Directional Movement Index (ADX).

By measuring the strength of price movement, momentum indicators help investors determine whether current price movement more likely represents relatively insignificant, range-bound trading or an actual, significant trend. Because momentum indicators measure trend strength, they can serve as early warning signals that a trend is coming to an end. For example, if a security has been trading in a strong, sustained uptrend for several months, but then one or more momentum indicators signals the trend steadily losing strength, it may be time to think about taking profits.

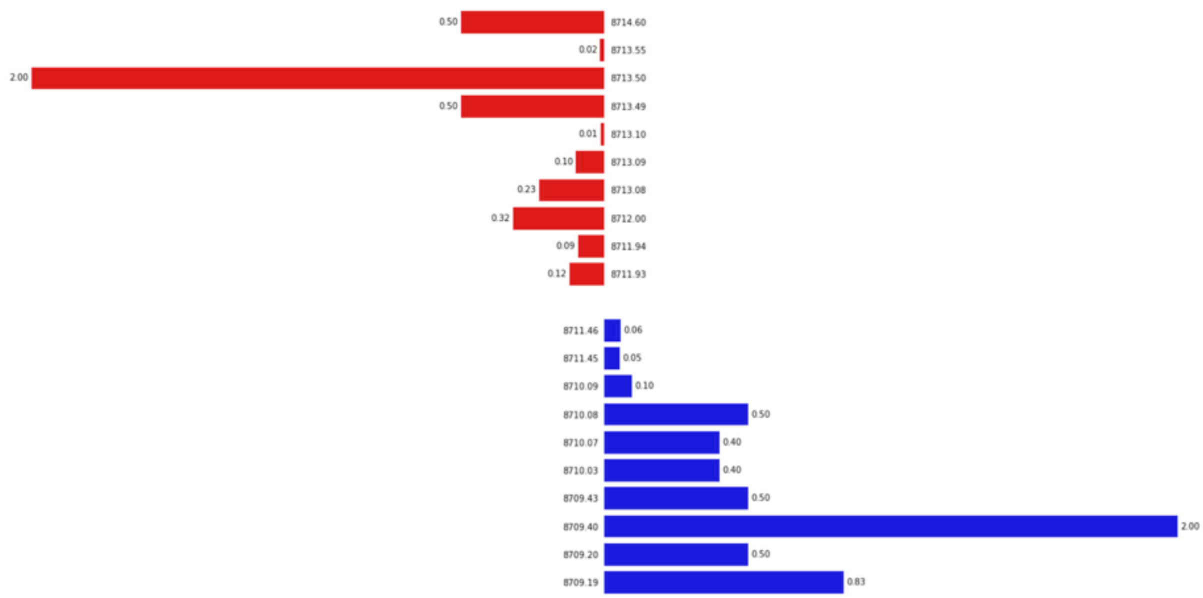
The 4-hour chart of USD/SGD below illustrates the value of a momentum indicator. The MACD indicator appears in a separate window below the main chart window. The sharp upturn in the MACD beginning around June 14th indicates that the corresponding upsurge in price is a strong, trending move rather than just a temporary correction. When price begins to retrace downward somewhat on the 16th, the MACD shows weaker price action, indicating that the downward movement in price does not have much strength behind it. Soon after that, a strong uptrend resumes. In this instance, the MACD would have helped provide reassurance to a buyer of the market that (A) the turn to the upside was a significant price move and (B) that the uptrend was likely to resume after price dipped slightly on the

16th.



Because momentum indicators generally only signal strong or weak price movement, but not trend direction, they are often combined with other technical analysis indicators as part of an overall trading strategy.

Limit Order Book (LOB)



A limit order book is a record of outstanding limit orders maintained by the security specialist who works at the exchange. A limit order is a type of order to buy or sell a security at a specific price or better. A buy limit order is an order to buy at a preset price or lower while a sell limit order is an order to sell a security at a pre-specified price or higher.

When a limit order for a security is entered, it is kept on record by the security specialist. As buy and sell limit orders for the security are given, the specialist keeps a record of all these orders in the order book. The specialist executes the orders at or better than the given limit price when the market moves to the pre-specified price.

The specialist running the limit order book has the responsibility to guarantee that the top priority order is executed before other orders in the book, and before other orders at an equal or worse price held or submitted by other traders on the floor, such as floor brokers and market makers.

The specialist earns a profit from the spread between the difference in prices between the bid and ask orders on their book as they execute the orders. With the advancements in trading system technologies, the process has shifted from a manual process to one that is largely automated.

In 2000, the Securities and Exchange Commission (SEC) began to create a centralized limit order book that keeps track of limit orders on exchanges electronically.1 This electronic order tracking system automatically matches for the execution of the best possible pair of orders in the system. The best pair is made up of the highest bid, and the lowest ask orders. The bid is the price the specialist or exchange will sell a security or the price at which an investor can buy the security. The ask or offer is the price at which the specialist or exchange will buy a security or the price at which the investor can sell the security.

When a limit order is entered into a trading system and fielded by either a specialist working the book or an electronic database of orders, it will stay on the books until it can be matched with a suitable trade and executed. Buy limit orders are placed with an upper price threshold. The investor would say "I don't want to pay more than $X for this share." Sell limit orders are placed with a lower price threshold. The investor would say "I don't want to sell this share for less than $X."

For a more detailed description click on limit order book.

Thinkorswim by TD Ameritrade

An electronic trading platform used to trade financial assets. It is geared for self-directed stock, options and futures traders which was previously offered by ThinkorSwim Group, Inc and was purchased by TD Ameritrade in 2009.

It provides services for self-directed option traders and institutional users who invest in equities, exchange-traded funds, futures, mutual funds and bonds.

Thinkorswim provides financial literacy services for self-directed investors including trading tools and analytics. It offers a range of investor education products in a variety of interactive delivery formats, including instructor-led synchronous and asynchronous online courses, in-person workshops, one-on-one and one-to-many online coaching programs and telephone, live-chat and email support. Thinkorswim is used in conjunction with trades of equity securities, fixed income, index products, options, futures, other derivatives and foreign exchange. The Thinkorswim software is provided free for account holders of TD Ameritrade and trades via the TD Ameritrade platform are free.

JPM eFX DNA "Deep Neural Network for Algo Execution"

J.P. Morgan is taking technology to a new level in the foreign exchange market, applying machine learning to provide competitive pricing and optimize execution in what is already one of the most liquid and automated asset classes alongside equities. The Deep Neural Network for Algo Execution (DNA) is J.P. Morgan's latest tool to enhance its FX algorithms and uses a machine learning framework to bundle certain existing algos into one streamlined execution strategy.

“DNA is an optimization feature that leverages simulated data from various types of market conditions to select the best order placement and execution style designed to minimize market impact," said Chi Nzelu, head of Macro eCommerce at J.P. Morgan. “It then uses reinforcement learning – a subset of machine learning – to assess the performance of individual order placement choices."

[Read more...]

Oscillators

An oscillator is a technical analysis tool that constructs high and low bands between two extreme values, and then builds a trend indicator that fluctuates within these bounds. Traders use the trend indicator to discover short-term overbought or oversold conditions. When the value of the oscillator approaches the upper extreme value, technical analysts interpret that information to mean that the asset is overbought, and as it approaches the lower extreme, technicians consider the asset to be oversold.

The Relative Strength Index is arguably the most popular technical indicator when it comes to trading. But being popular doesn’t always make you right or easy. David Jones knows this and is here to give a helping hand to those just starting their journey in the world of the markets, as well as those who’ve had a bit more experience.

Order Flow

Order flow defines the amount of orders waiting to be executed at a certain price level.

While the price is rising upward in a very strong rally, we know for certain that it will eventually stop somewhere. The rally up happens because there are simply more traders willing to buy than traders that are willing to sell. This creates an imbalance between buyers and sellers, whereas there are more buyers demanding the supply, therefore price shifts upwards. Eventually, the buyer momentum will end and the price will be driven up to a level where there are more sellers than buyers. This new imbalance created by more sellers than buyers will push price downwards.

This simple scenario is what happens in the markets on the macro and micro levels. This is the essence of what makes price move range or reverse.

When you look at a chart of a moving price and interpret this to the forces balance placed on different price levels.

Take a deeper look at Order Flow and VPIN here.

Tools for a Fundamental Analysis

Cross-Sectional Analysis

Cross-sectional analysis is a type of analysis where an investor, analyst or portfolio manager compares a particular company to its industry peers. Cross-sectional analysis may focus on a single company for head-to-head analysis with its biggest competitors or it may approach it from an industry-wide lens to identify companies with a particular strength.

Cross-sectional analysis is often deployed in an attempt to assess performance and investment opportunities using data points that are beyond the usual balance sheet numbers.

When conducting a cross-sectional analysis, the analyst uses comparative metrics to identify the valuation, debt-load, future outlook and/or operational efficiency of a target company. This allows the analyst to evaluate the target company's efficiency in these areas, and to make the best investment choice among a group of competitors within the industry as a whole.

Analysts implement a cross-sectional analysis to identify special characteristics within a group of comparable organizations, rather than to establish relationships. Often cross-sectional analysis will emphasize a particular area, such as a company's war chest, to expose hidden areas of strength and weakness in the sector. This type of analysis is based on information-gathering and seeks to understand the "what" instead of the "why." Cross-sectional analysis allows a researcher to form assumptions, and then test their hypothesis using research methods.

AQR - How It Places Bets Against Beta

AQR, a large hedge fund founded by famed investor Cliff Asness, uses a strategy of statistical arbitrage by taking a short position in stocks with high beta and a long position in stocks with a low beta. This strategy is known as a bet against beta. The theory is based on alleged inefficiencies with the capital asset pricing model, or CAPM, due to large funds being constrained in the type of leverage they can utilize and the risk they can take.1 Beta is a statistical measure of the risk of an individual stock or portfolio against the market as a whole. The phrase bet against beta was coined from a few economics papers written by the creators of the strategy.

Beta is a measure of the risk that cannot be reduced by diversification. A beta of one means a stock or portfolio moves exactly in step with the larger market. A beta greater than one indicates an asset with higher volatility tends to move up and down with the market. A beta of less than one indicates an asset less volatile than the market or a higher volatility asset not correlated with the larger market. A negative beta shows an asset moves inversely to the overall market. Some derivatives such as put options have consistently negative betas.

CAPM is a model that calculates the expected return on an asset or portfolio. The formula determines the expected return as the prevailing risk-free rate plus the return of the market minus the risk-free rate times the beta of the stock. The security market line, or SML, is a result of CAPM. It shows an expected rate of return as a function of non-diversifiable risk. The SML is a straight line that shows the risk-return tradeoff for an asset. The slope of the SML is equal to the market risk premium. The market risk premium is the difference between the expected return on a market portfolio and the risk-free rate.

The basic bet against beta strategy is to find assets with higher betas and take a short position in them. At the same time, a leveraged long position is taken in assets with lower betas. The idea is the higher beta assets are overpriced and the lower beta assets are underpriced. The theory posits the prices of the stocks eventually come back into line with each other. This is essentially a statistical arbitrage strategy with the prices of the assets coming back to the median price versus risk. This median is defined as the SML.

A main tenet of CAPM is all reasonable investors invest their money in a portfolio with the highest expected excess return per unit of risk. The expected excess return per unit of risk is known as the Sharpe ratio. The investor can then leverage or reduce this leverage based on his individual risk preferences. However, many large mutual funds and individual investors are constrained in the amount of leverage they can use. As a result, they have a tendency to overweight their portfolios toward higher beta assets to improve returns.

This tilting toward higher beta stocks indicates these assets require lower risk-adjusted returns versus lower beta assets. Essentially, some experts believe the slope of the SML line is too flat for the U.S. market versus CAPM.1 This allegedly creates a pricing anomaly in the market in which some attempt to profit. Some economic papers doing historical backtesting have shown superior Sharpe ratios versus the market as a whole.

In examining this phenomenon, AQR has constructed market-neutral betting against beta factors that can be used to measure this idea.1 As a practical matter, the performance of this strategy suffers due to commissions and other trading expenses.3

As such, it may not be useful for individual investors. The strategy likely requires a large amount of capital and access to low trading costs to be successful.

Sentiment Analysis

A Social Sentiment Indicator

A social sentiment indicator analyzes aggregated social media data to help b usinesses understand how they are performing in the eyes of consumers. So cial sentiment indicators enable companies to discover what they are doing r ight and how they might improve.
These measures can also give investors an idea of how publicly listed stocks

might perform. Social Sentiment should not be confused with market sentiment indicators, which are designed to represent how a group or population feels about the overall market or economy. Keeping customers cheerful is paramount for companies targeting long-term success. When the public is happy with a service or product, and all its other interactions with the provider, company revenues profits are more likely to rise.

In the digital age, it has become much easier for companies and investors to gauge how well businesses are treating their customers. Social sentiment indicators can tell us a lot about the public perception of a company, at least in terms of what is being said on social media.

These indicators extract information users post publicly to Facebook, Twitter, blog posts, discussion groups, and forums. If the social sentiment indicator shows a negative change in reputation, the company might be able to address the problem before it grows and starts potentially heavily weighing on its share price.

The Advantages of Social Sentiment Indicators

Social sentiment indicators serve a variety of purposes. Companies might blame social media for triggering a rise in complaints and encouraging hate campaigns. However, these same firms can use the internet and social sentiment indicators to their advantage, too, including in the following ways:

- Identify trends to target new customers
- Develop successful marketing campaigns and gauge if they are spending marketing dollars wisely
- Determine how consumers feel about competitors and similar products
- Assess what to expand on and what to drop or change
- Protect and improve their brand identity and image

Social sentiment indicators are also helping to reduce the burden on customer service email and call centers. Nowadays, it is possible to address questions and problems en masse via social media. In some cases, these communication methods might even be used to reach out to highly influential individuals with a track record of swaying sentiment on popular chat platforms.

Investors, too, can benefit from social sentiment indicators because the type of information that they collate tends to have a bearing on stock prices. If an investor spots that people on social media have suddenly started to complain about a particular company, they could opt to sell before the rest of the market reacts. Value investors, on the other hand, might use these tools to buy into a stock that they believe has been excessively punished by internet gossip.

Third-Party Information Can Enhance Data Analytics

Using third-party data sources can be challenging, but it is crucial for companies who want to gain an analytics edge to tap into data ecosystems. Analyzing external data can help companies see the risks and opportunities that they would miss with inputs limited to data generated from internal operations, customers, and first-tier suppliers.

According to one study, the data stored in data centers will nearly quintuple by 2021, reaching 1.3 zettabytes globally. Along with the volume of data available, the potential value of analyzing this data grows bigger by the day.

It's not surprising that companies on the leading edge of data and analytics are more likely to make use of external data. An MIT Sloan Management Review report published last year found that the companies making the most innovative use of data and analytics were more likely than others to leverage more external data sources, including social, mobile, and publicly available data.

Marketing offers, improved HR processes and new revenue streams gained from new products and services and anticipated shifts in demand are influenced by external data sources. Models have been built from data sourced from third party data to predict the best types of customers to market to with the appropriate campaigns. Several startups monitor data from social networks to predict job-seeking behavior and retention risk.

Size of the data and the complexity of how the data was obtained are challenges for those using external data. Other challenges of using external data include the refresh rate of the data, usage restrictions, if shared revenue is an expectation of the vendor and contractual agreements with the vendor.

Profitability Ratios

Objectives:

- Students will be able to define what profitability ratio is
- Students will be able to apply the Return on Equity equation when provided with a scenario of requisite inputs
- Students will be able to apply the Return on Assets equation when provided with a scenario of requisite inputs
- Students will be able to apply the Gross Margin Ratio equation when provided with a scenario of requisite inputs
- Students will be able to apply the Return on Capital Employed equation when provided with a scenario of requisite inputs
- Students will be able to apply the Operating Profit Margin equation when provided with a scenario of requisite inputs
- Students will be able to apply theNet Profit Margin equation when provided with a scenario of requisite inputs

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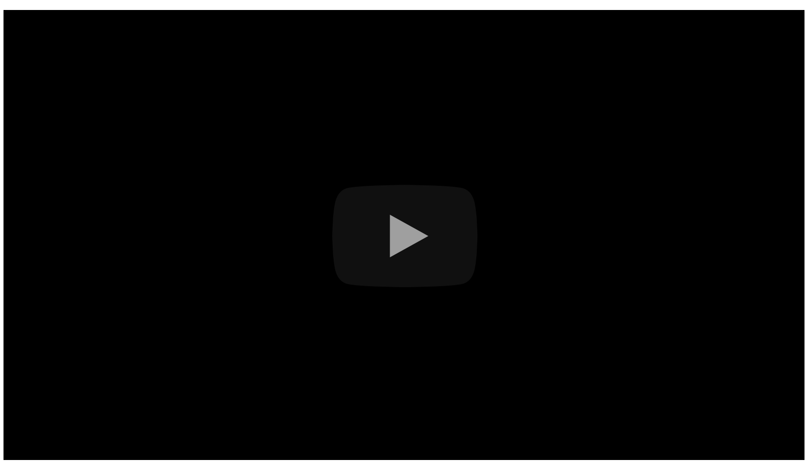
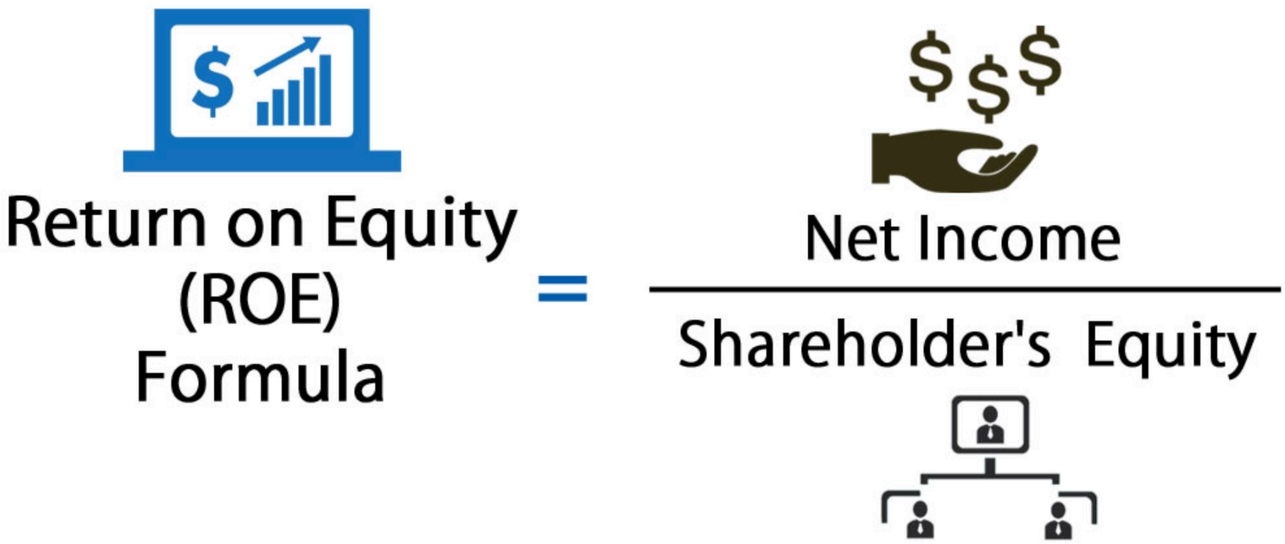


Return on Equity

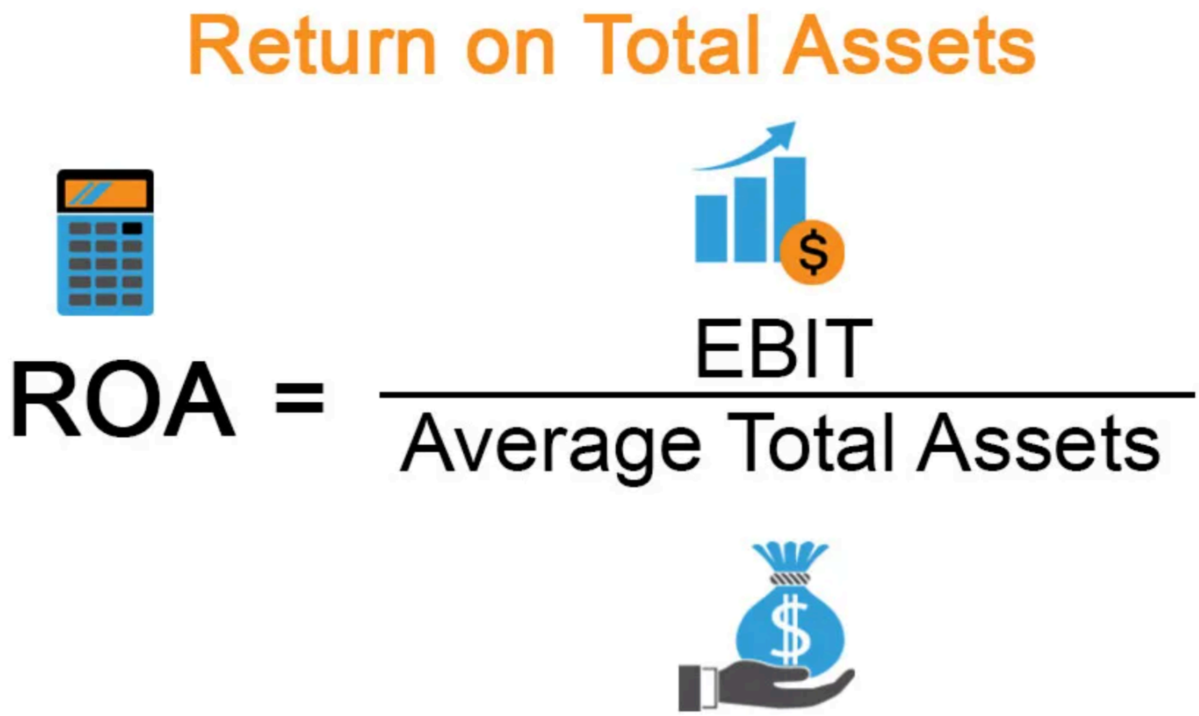


Return on equity (ROE) is a percentage measure of a company's yearly return (net income) divided by the value of its entire shareholders' equity (e.g., 10 percent). ROE may also be calculated by dividing the company's dividend growth rate by its profits retention rate (1-dividend payout ratio). There are numerous ROE drivers, and the ratio will be broken down further.

ROE = Net Income / Shareholders' Equity

The return on equity (ROE) is a basic statistic for analyzing returns. It is feasible to determine a company's competitive advantage by comparing its ROE to the industry average (or lack of competitive advantage). Return on equity (ROE) looks at the bottom line to determine overall profitability for the firm's owners and investors since it utilizes net income as the numerator. This is an important ratio to consider as an investor since it ultimately decides how appealing an investment is. Asset efficiency, profitability, and financial leverage all affect return on equity.

Return on Assets



The return on assets (ROA) is a sort of profitability ratio that compares a company's profitability to its total assets. This ratio compares a company's earnings (net income) to the total capital it has invested in assets to determine how well it is operating. The bigger the return, the more productive and effective the management is in its use of financial resources. The ROA formula is broken down below.

ROA = Net Income / Total Assets

The ROA formula is a crucial metric for determining a company's profitability. When evaluating a company's performance over time, or when comparing two businesses of comparable size and industry, the ratio is commonly employed. When comparing two distinct businesses using ROA, it is critical to evaluate the size of the business and the operations conducted. Varying industries often have different ROAs. Industries that are capital-intensive and require a high value of fixed assets for operations would often have a lower ROA, since the denominator of the formula will be increased by their big asset base.

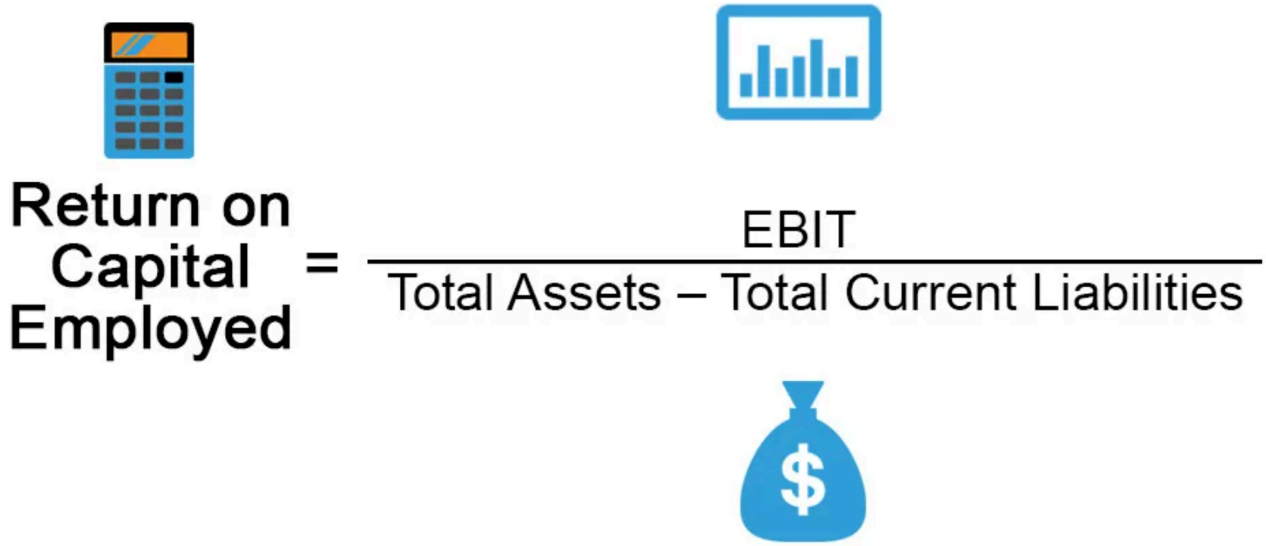
Gross Margin Ratio

The gross margin ratio, commonly known as the gross profit margin ratio, compares a company's gross margin to its earnings after paying off its cost of goods s profitability ratio revenue. It demonstrates how much profit a firm has made over time (COGS). Because the ratio reveals what proportion of each dollar of revenue the firm keeps as gross profit, a high gross margin ratio is desirable.

Gross Margin Ratio = Gross Profit / Total Revenue = (Total Revenue – COGS) / Total Revenue

A low gross margin ratio does not always imply that a firm is underperforming. Rather than comparing gross margin percentages between sectors, it's crucial to compare them between firms in the same industry. Because it works in a service business with low production costs, a legal service company, for example, has a high gross margin ratio. A vehicle manufacturing business, on the other hand, will have a lower ratio due to high production expenses.

Return on Capital Employed

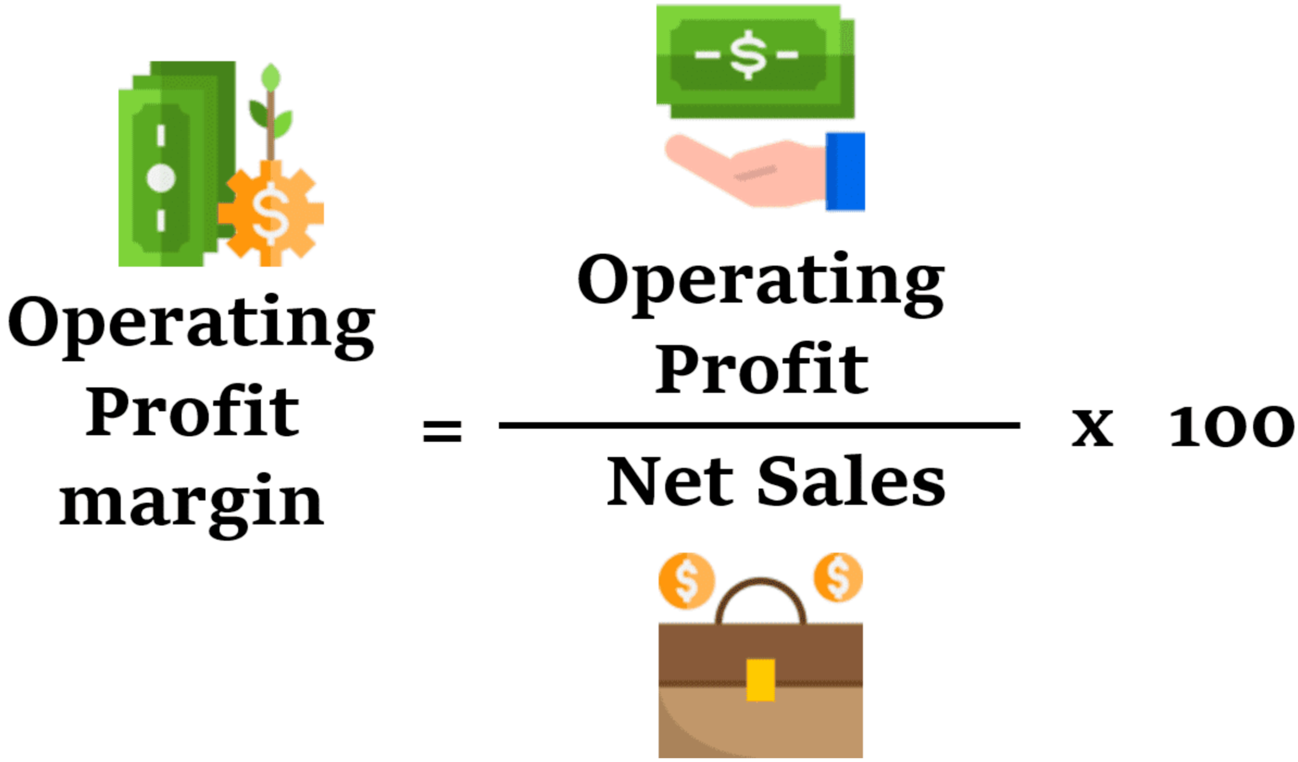


Return on Capital Employed (ROCE) is a profitability statistic that determines how well a business uses its capital to create profits. One of the finest profitability statistics is return on capital employed, which is frequently used by investors to assess if a firm is viable for investment.

ROCE = EBIT / Capital Employed = EBIT / (Total Assets – Current Liabilities)

The return on capital employed measures how much operational revenue is generated for every dollar spent on capital. A greater ROCE is usually preferable since it means more earnings are earned per dollar of invested capital. Calculating a company's ROCE alone, like any other financial measure, is insufficient. Other profitability ratios, such as return on assets, return on invested capital, and return on equity, should be utilized with ROCE to assess whether or not a firm is genuinely successful.

Operating Profit Margin

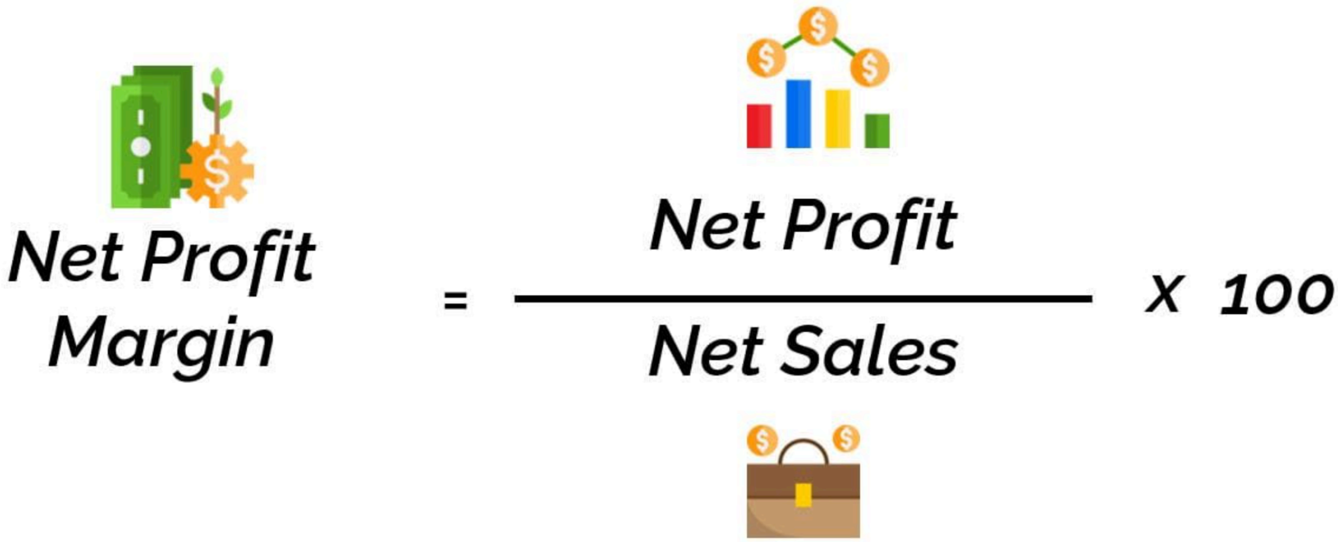


The operating profit margin is a profitability measure that calculates the proportion of profit generated by a company's activities before taxes and interest costs are deducted. It is presented as a percentage and is derived by dividing operational profit by total revenue. The EBIT (Earnings Before Interest and Tax) margin is another name for the margin.

Operating Profit Margin = EBIT / Total Revenue = (Total Revenue – COGS – Operating Expenses – Amortization) / Total Revenue

The operational profit margin is calculated as a percentage of total sales divided by operating profit. A 30 percent operational profit margin, for example, equates to $0.30 in operating profit for every $1 in revenue. An acquirer considering a leveraged buyout is a good illustration of how this profit metric may be applied. When the acquirer examines the target firm, they will be searching for ways to enhance the operations. The operational profit margin reveals how effectively the target firm performs in contrast to its competitors, and in particular, how well it controls its expenditures to optimize profitability. The removal of interest and taxes is advantageous since a leveraged buyout would infuse a firm with entirely fresh debt, rendering past interest expenditure obsolete.

Net Profit Margin



The net profit margin (also known as "profit margin" or "net profit margin ratio") is a financial statistic that determines the proportion of profit a firm generates from total sales. It calculates how much net profit a firm makes per dollar of revenue. The net profit margin is calculated by dividing net profit (also known as net income) by total revenue and expressing the result as a percentage.

Net Profit Margin = Net Income / Total Revenue

By subtracting all of the company's costs from its total income, net profit is determined. The profit margin computation yields a percentage - for example, a 30 percent profit margin indicates the firm generates $0.30 in net profit for every $1 in revenue. The total sales of a firm in a certain period are referred to as revenue. The usual profit margin ratio of any firm varies based on the industry in which it operates.

Efficiency Ratios

Objectives:

- Students will be able to apply the Asset Turnover Ratio Formula when provided with a scenario of requisite inputs
- Students will be able to apply the Inventory Turnover Ratio Formula when provided with a scenario of requisite inputs
- Students will be able to apply the Days in Inventory Formula when provided with a scenario of requisite inputs

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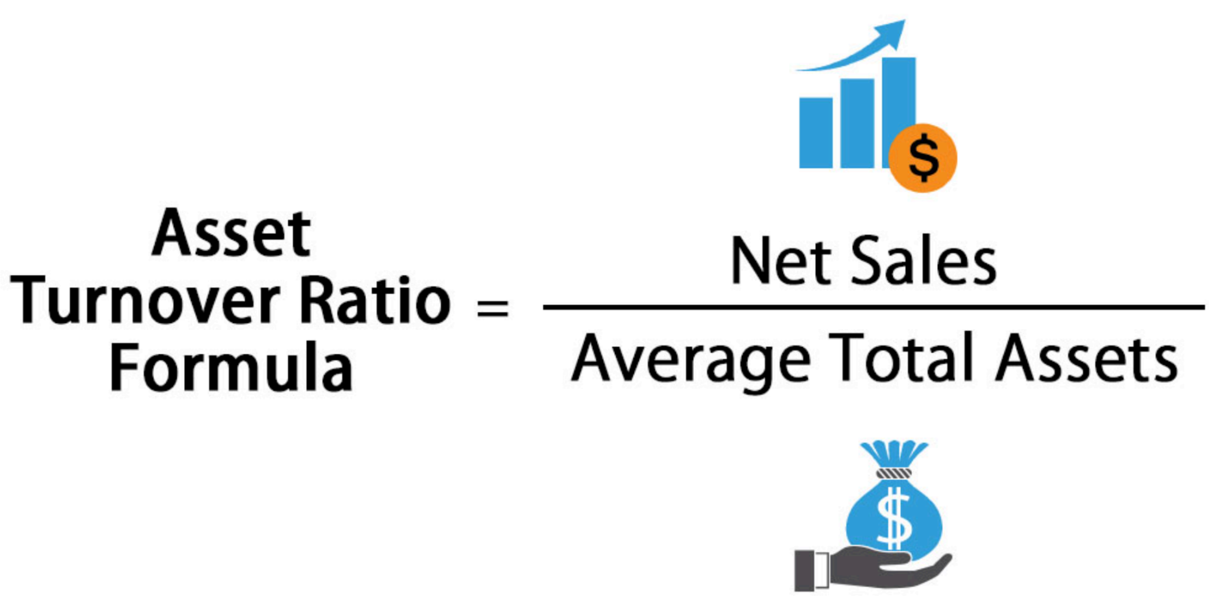
Asset Turnover Ratio



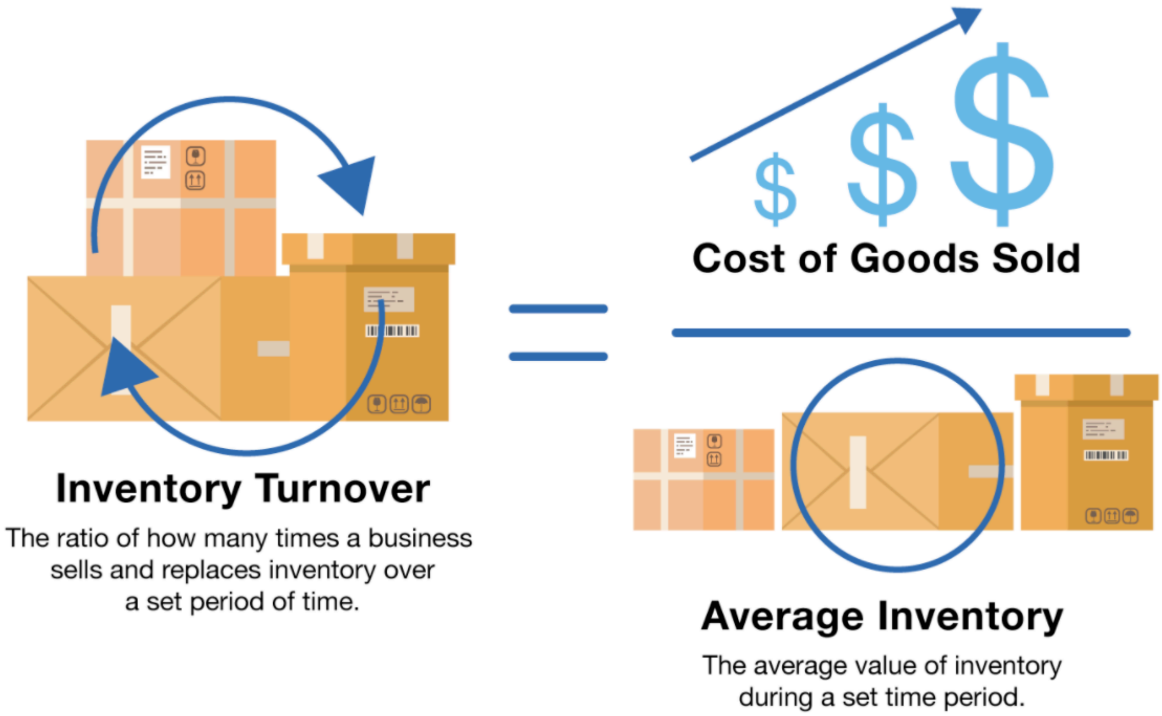
The asset turnover ratio is a measurement which allows to identify how well a company operates its assets in order to produce revenue. This ratio examines how much revenue is earned per dollar of total assets owned by the firm.

Asset Turnover Ratio = Net Sales / Average Total Assets

Average total assets = (Total Assetsending + Total Assetsbeginning)/2 is the formula used to compute this ratio. Note that instead of using average total assets, an analyst might utilize period end total assets. For example, a company's net sales for the year total $100,000. The company's total assets on December 31st were $65,000. The company's entire assets on January 1st were $57,000. The asset turnover ratio of the firm would thus be equal to 100,000/((65,000 + 57,000)/2) = 1.64. This indicates that the firm produces roughly $1.64 in net sales for every dollar of total assets.

A single period's asset turnover ratio, like many other ratios, isn't very informative on its own. When compared to asset turnover ratios of similar firms in the same industry, however, it might show how well a company is performing in comparison to its competitors. The optimum or average asset turnover ratio is determined by the company's industry. A greater ratio is typically considered positive since it implies that assets are being used efficiently. A low ratio, on the other hand, may indicate inefficient asset usage, collecting techniques, or inventory management.

Inventory Turnover Ratio



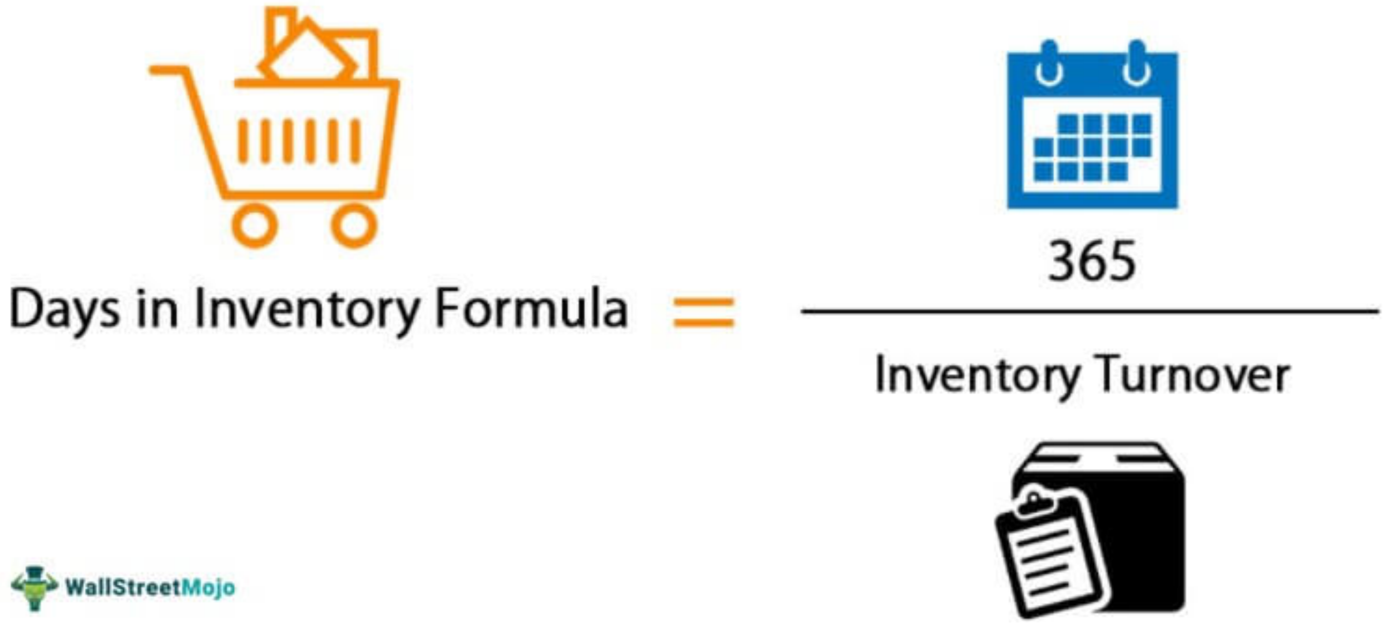
The inventory turnover ratio calculates how many times a company's stock of goods is sold and replaced in a particular period of time. This ratio examines the cost of products sold in relation to the period's average inventory. This metric shows how effective a company is in clearing its stockpiles.

Inventory Turnover Ratio = Cost of Goods Sold / Average Inventory

The average inventory ratio is determined as follows: Average Inventory = (Inventoryending + Inventorybeginning)/2. For example, a company's cost of goods sold for the fiscal year is $3 million. The company's inventory was $350,000 on December 31st. Inventory was $260,000 on January 1st. As a result, the inventory turnover ratio for the firm would be = 3,000,000 / ((35,000 + 26,000)/2) = 9.84. This figure indicates that the firm sold its whole inventory stock 9.84 times throughout the fiscal year.

The inventory turnover ratio, like the accounts receivable turnover ratio, may be adjusted to produce inventory turnover days, which is the average number of days it takes to sell a complete stock of products.

Inventory Turnover Days



The average number of days it takes to sell a stock of inventory is known as Inventory Turnover Days. This formula is derived from the inventory turnover ratio previously discussed. Inventory turnover days, like the inventory turnover ratio, is a measure of a company's efficiency.

Inventory Turnover Days = Number of Days in Period / Inventory Turnover Ratio

The inventory turnover ratio is required to compute this ratio: Cost of Goods Sold/Average Inventory = Inventory Turnover Ratio Using the same example, a company's cost of goods sold for the fiscal year is $3 million. The company's inventory was $350,000 on December 31st. Inventory was $260,000 on January 1st. As a result, the inventory turnover ratio for the firm would be = 3,000,000/((35,000 + 26,000)/2) = 9.84. This figure indicates that the firm sold its whole inventory stock 9.84 times throughout the fiscal year. These figures may be used to determine inventory turnover days, which are = 365/9.84 = 37.1.

Based on this, the company's average time to sell an entire stock of inventory is 37.1 days. This number should be compared to industry averages, just like the inventory turnover ratio, to see how efficient the company is at converting inventory into sales compared to its competitors.

Liquidity Ratios

Objectives:

- Students will be able to apply the Current Ratio Formula when provided with a scenario of requisite inputs
- Students will be able to apply the Quick Ratio Formula when provided with a scenario of requisite inputs
- Students will be able to apply the Cash Ratio Formula when provided with a scenario of requisite inputs

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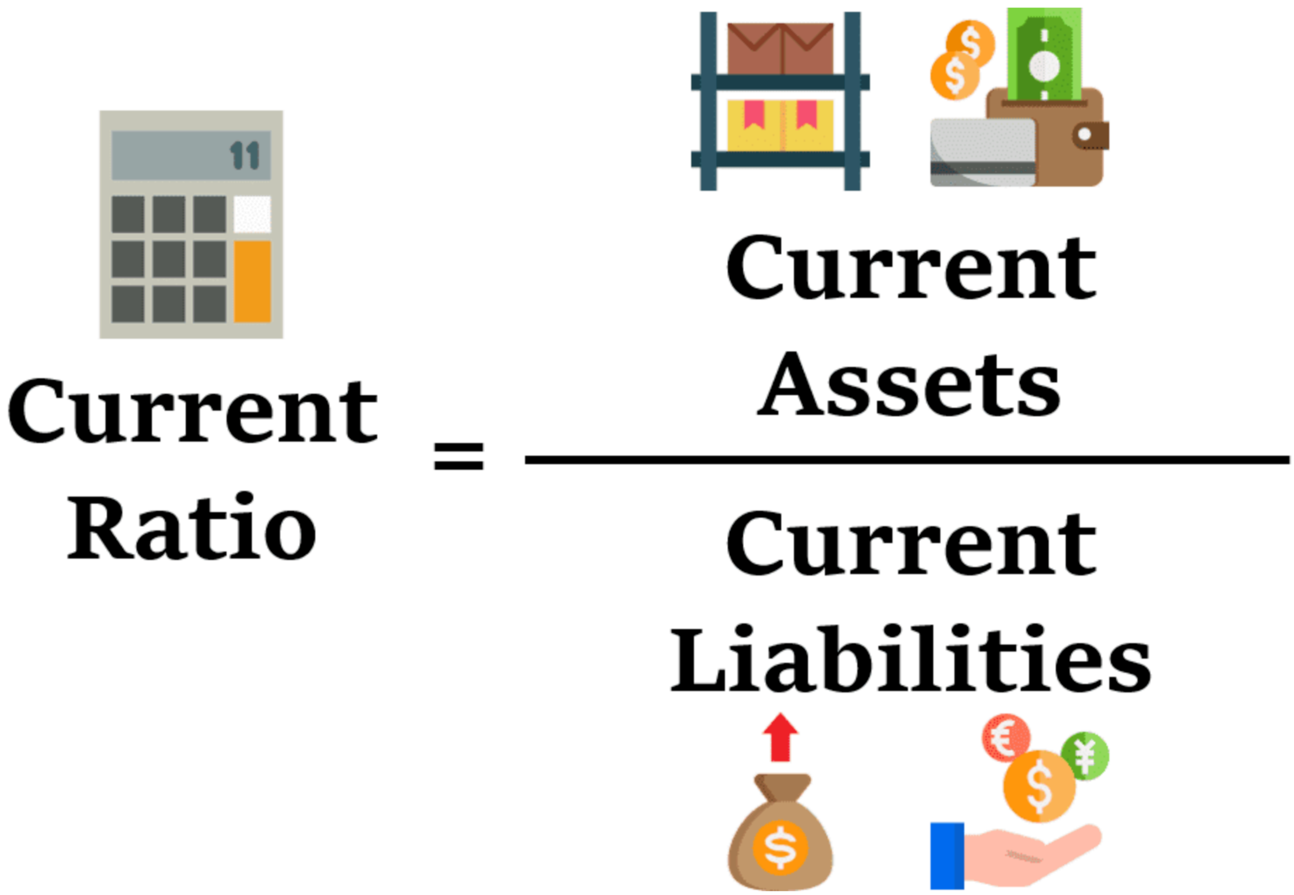
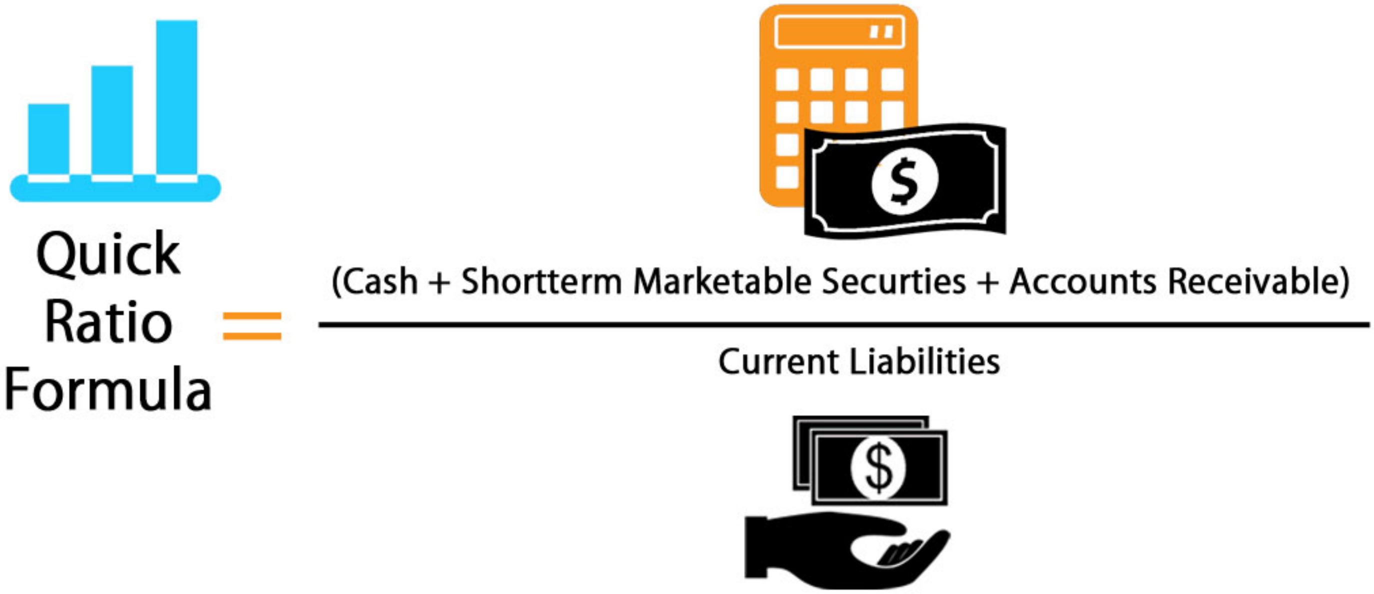


The current ratio, also known as the working capital ratio, assesses a company's capacity to fulfill short-term commitments due within one year. Total current assets are compared to total current liabilities in this ratio. The current ratio examines a company's ability to optimize the liquidity of its current assets in order to meet its debt commitments.

Current Ratio = Current Assets / Current Liabilities

Because it covers all current assets, including cash marketable securities, accounts receivable, and inventories, the current ratio is more comprehensive than other liquidity ratios like the quick ratio. The current ratio of a company with $60 million in current assets and $30 million in current liabilities is 2. According to this ratio of 2, a company's current obligations, such as accounts payable, may be paid off twice using current assets. A current ratio greater than one usually indicates a company's financial health. A high current ratio, on the other hand, indicates that the firm is sitting on too much cash rather than investing it in projects that will help the company expand.

Quick Ratio



The quick ratio, also known as the acid-test ratio, assesses a company's capacity to meet short-term obligations by identifying assets that may be converted into cash quickly. Cash, marketable securities, and accounts receivable are examples of these assets. These assets are referred to be "quick" assets since they can be turned into cash fast and readily.

Quick Ratio = (Cash + Marketable Securities + Accounts Receivable) / Current Liabilities

The fast ratio, unlike the current ratio, only considers the most liquid assets. The fast ratio assesses a company's capacity to meet short-term obligations using only assets that can be turned into cash rapidly. As a result, items like inventory and prepaid costs are excluded from the quick ratio. A company's quick ratio is 1.52 if it has $20 million in cash, $10 million in marketable securities, $18 million in accounts receivable, and $25 million in current liabilities. This means that the company's most liquid assets can cover 1.52 times its current liabilities.

A fast ratio larger than one indicates that the firm is financially healthy, since it indicates that the corporation can fulfill its short-term debt commitments using solely its liquid assets. A high quick ratio, like a high current ratio, indicates that the firm is leaving too much extra cash on the table rather than investing it to create returns or growth.

Cash Ratio

The cash ratio, also known as the cash asset ratio, assesses a company's capacity to repay short-term debt commitments using cash and cash equivalents. The cash ratio is a tighter, more conservative metric than the current and quick ratios since it only considers cash and cash equivalents — a company's most liquid assets. Cash equivalents are assets that can be rapidly turned into cash and carry a low degree of risk. Savings accounts, Treasury notes, and money market instruments are examples of cash equivalents.

Cash Ratio = Cash and Cash Equivalents / Current Liabilities

Because it solely utilizes cash and cash equivalents in its computation, the cash ratio is more tighter than the current and quick ratios. The cash ratio shows how much cash and cash equivalents can meet a company's short-term debt commitments. A cash ratio of 0.6 means a firm has $10 million in cash, $5 million in treasury bills, and $25 million in current obligations. This indicates the company can cover 60% of its current liabilities with cash and cash equivalents, or 0.6 times its current liabilities.

A greater crash ratio is preferred by creditors since it implies that the firm can readily repay its loan. Although there is no optimal ratio, a ratio of 0.5 to 1 is typically chosen. A high cash ratio, like the current and quick ratios, shows that the firm is hoarding cash rather than investing it to generate returns or growth.

CAPM & Fama and French Three

Objectives:

- Students will be able to define what the Capital Asset Pricing Model (CAPM) is.
- Students will be able to define the parts of the CAPM formula.
- Students will be able to apply the CAPM formula.
- Students will be able to describe the assumptions and problems with the CAPM.
- Students will be able to explain the principles of the Modern Portfolio Theory.
- Students will be able to show an understanding of the Fama and French Three-Factor Model.
- Students will be able to explain how the Fama and French Three-Factor Model relates to investors.
- Students will be able to describe the three factors of the Fama and French Three-Factor Model.

CAPM

The Capital Asset Pricing Model (CAPM) describes the relationship between systematic risk and expected return for assets, notably stocks. It is used throughout finance for pricing risky securities and generating expected returns for assets given the risk of those assets and cost of capital.

[redacted]

Understanding CAPM

$$ER_i = R_f + \beta_i(ER_m - R_f)$$

$$\textbf{where:}$$

$$ER_i = \text{expected return of investment}$$

$$R_f = \text{risk-free rate}$$

$$\beta_i = \text{beta of the investment}$$

$$(ER_m - R_f) = \text{market risk premium}$$

Investors expect to be compensated for risk and the time value of money. The risk-free rate in the CAPM formula accounts for the time value of money. The other components of the CAPM formula account for the investor taking on additional risk.

The beta of a potential investment is a measure of how much risk the investment will add to a portfolio that looks like the market. If a stock is riskier than the market, it will have a beta greater than one. If a stock has a beta of less than one, the formula assumes it will reduce the risk of a portfolio.

A stock's beta is then multiplied by the market risk premium, which is the return expected from the market above the risk-free rate. The risk-free rate is then added to the product of the stock's beta and the market risk premium. The result should give an investor the required return or discount rate they can use to find the value of an asset.

The goal of the CAPM formula is to evaluate whether a stock is fairly valued when its risk and the time value of money are compared to its expected return.

For example, imagine an investor is contemplating a stock worth $100 per share today that pays a 3% annual dividend. The stock has a beta compared to the market of 1.3, which means it is riskier than a market portfolio. Also, assume that the risk-free rate is 3% and this investor expects the market to rise in value by 8% per year.

The expected return of the stock based on the CAPM formula is 9.5%:

9.5% = 3% + 1.3 x (8% - 3%)

The expected return of the CAPM formula is used to discount the expected dividends and capital appreciation of the stock over the expected holding period. If the discounted value of those future cash flows is equal to $100 then the CAPM formula indicates the stock is fairly valued relative to risk.

Problems with CAPM

Modern financial theory rests on two assumptions: securities markets are ver y competitive and efficient; these markets are dominated by rational, risk-averse investors, who seek to maximize satisfaction from returns on their investments. Despite these issues, the CAPM formula is considered as a useful resource because of its simplicity and allows for easy comparisons of investment alternatives.

Including beta in the formula assumes that risk can be measured by a stock's price volatility. The look-back period to determine a stock's volatility is not standard because stock returns are not normally distributed. An increase in the risk-free rate also increases the cost of the capital used in the investment and could make the stock look overvalued.

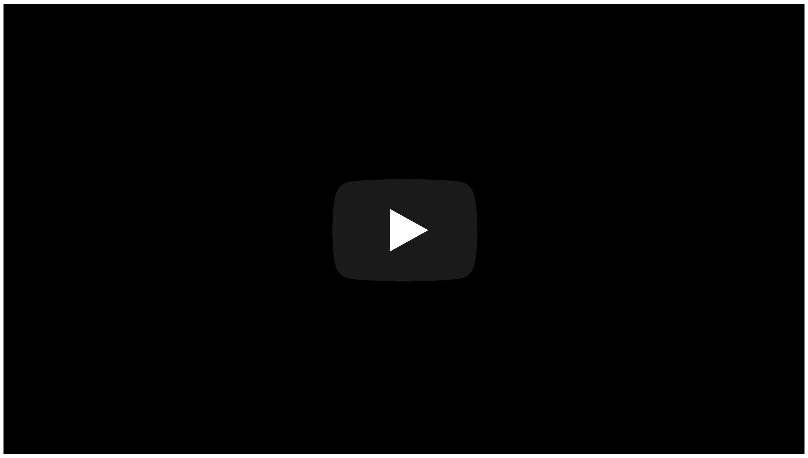
The market portfolio that is used to find the market risk premium is only a theoretical value and is not an asset that can be purchased or invested in as an alternative to the stock. Most of the time, investors will use a major stock index, like the S&P 500, to substitute for the market, which is an imperfect comparison.

If an investor could estimate the future return of a stock with a high level of accuracy, the CAPM would not be necessary.

The CAPM and the Efficient Frontier

If an investor wants to manage their risk, the CAPM is

supposed to help by using it to build the portfolio. If it were to be used perfectly to optimize the portfolio's return relative to risk, it would exist on a curve call the efficient frontier.



The CAPM uses the principles of Modern Portfolio Theory to determine if a security is fairly valued. It relies on assumptions about investor behaviors, risk and return distributions, and market fundamentals that don’t match reality. However, the underlying concepts of CAPM and the associated efficient frontier can help investors understand the relationship between expected risk and reward as they make better decisions about adding securities to a portfolio.

Fama and French Three Factor Model

The Fama and French Three-Factor Model (or the Fama French Model for short) is an asset pricing model developed in 1992 that expands on the capital asset pricing model (CAPM) by adding size risk and value risk factors to the market risk factor in CAPM. This model considers the fact that value and small-cap stocks outperform markets on a regular basis. By including these two additional factors, the model adjusts for this outperforming tendency, which is thought to make it a better tool for evaluating manager performance.

Understanding the Fama and French Three Factor Model

Nobel Laureate Eugene Fama and researcher Kenneth French, former professors at the University of Chicago Booth School of Business, attempted to better measure market returns and, through research, found that value stocks outperform growth stocks.1

Similarly, small-cap stocks tend to outperform large-cap stocks. As an evaluation tool, the performance of portfolios with a large number of small-cap or value stocks would be lower than the CAPM result, as the Three-Factor Model adjusts downward for observed small-cap and value stock outperformance.

The Fama and French model has three factors: the size of firms, book-to-market values, and excess return on the market. In other words, the three factors used are small minus big (SMB), high minus low (HML), and the portfolio's return less the risk-free rate of return. SMB accounts for publicly traded companies with small market caps that generate higher returns, while HML accounts for value stocks with high book-to-market ratios that generate higher returns in comparison to the market.2

There is a lot of debate about whether the outperformance tendency is due to market efficiency or market inefficiency. In support of market efficiency, the outperformance is generally explained by the excess risk that value and small-cap stocks face as a result of their higher cost of capital and greater business risk. In support of market inefficiency, the outperformance is explained by market participants incorrectly pricing the value of these companies, which provides the excess return in the long run as the value adjusts. Investors who subscribe to the body of evidence provided by the Efficient Markets Hypothesis (EMH) are more likely to agree with the efficiency side.

The formula is:

$$
\begin{aligned}
&R_{it} - R_{ft} = \alpha_{it} + \beta_1(R_{Mt} - R_{ft}) + \beta_2 SMB_t + \beta_3 HML_t + \epsilon_{it} \\
&\textbf{where:} \\
&R_{it} = \text{total return of a stock or portfolio } i \text{ at time } t \\
&R_{ft} = \text{risk free rate of return at time } t \\
&R_{Mt} = \text{total market portfolio return at time } t \\
&R_{it} - R_{ft} = \text{expected excess return} \\
&R_{Mt} - R_{ft} = \text{excess return on the market portfolio (index)} \\
&SMB_t = \text{size premium (small minus big)} \\
&HML_t = \text{value premium (high minus low)} \\
&\beta_{1,2,3} = \text{factor coefficients}
\end{aligned}
$$

Fama and French highlighted that investors must be able to ride out the extra volatility and periodic underperformance that could occur in a short time. Investors with a long-term time horizon of 15 years or more will be rewarded for losses suffered in the short term. Using thousands of random stock portfolios, Fama and French conducted studies to test their model and found that when size and value factors are combined with the beta factor, they could then explain as much as 95% of the return in a diversified stock portfolio.

Given the ability to explain 95% of a portfolio's return versus the market as a whole, investors can construct a portfolio in which they receive an average expected return according to the relative risks they assume in their portfolios. The main factors driving expected returns are sensitivity to the market, sensitivity to size, and sensitivity to value stocks, as measured by the book-to-market ratio. Any additional average expected return may be attributed to unpriced or unsystematic risk.

What Does Fama and French Three Factor Model Mean for Investors?

It tells investors that they must be able to ride out the extra volatility and periodic underperformance that could occur in the short term. Those who have a long-term time horizon of 15 or more years will be rewarded for losses suffered in the short term. Investors are able to tailor their portfolios to receive an average expected return according to the relative risks they assume thanks to the model being able to explain as much as 95% of the return in a diversified stock portfolio.

What Are the Three Factors of the Model?

- **Size of firms**
- **Book-to-Market Values**
- **Excess return on the market**

Ratio Analysis

Objectives:

- Students will be able to provide and describe the four levers to achieve growth and profit goals
- Students will be able to provide and describe the three core applications of ratio analysis
- Students will be able to apply the Ration Analysis equation when provided with a scenario of requisite inputs
- Students will be able to apply the Return on Equity equation when provided with a scenario of requisite inputs
- Students will be able to apply the Return on Assets formula when provided with a scenario of requisite inputs

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The profitability and expansion of a company define its worth. Product market and financial market strategies have an impact on a company's growth and profitability. The firm's competitive strategy, operational policies, and investment decisions are all used to implement the product market strategy. Financing and dividend policies are used to implement financial market strategies.

As a result, managers can utilize the following four levers to achieve their growth and profit goals:

1. Operating management
2. Investment management
3. Financing strategy
4. Dividend policies

Ratio analysis is used to assess the success of a company's policy in each of these categories. Effective ratio analysis entails as much information as possible in linking financial statistics to underlying company variables. While ratio analysis may not provide an analyst with all of the answers about a company's performance, it can assist the analyst formulate questions for future investigation.

The analyst can use ratio analysis to:

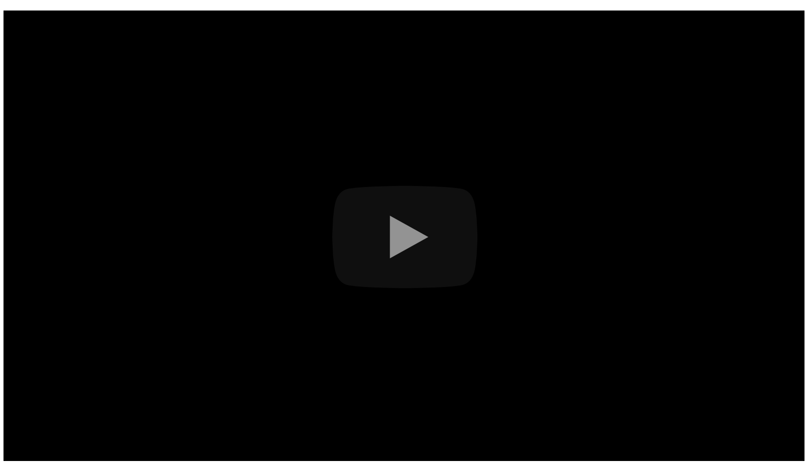
1. Compare ratios for a company across multiple years (a time-series comparison)
2. Compare the firm's ratios to those of other companies in the industry (cross-sectional comparison)
3. Compare the ratios to an absolute standard

An analyst can use a time-series comparison to assess the success of a firm's strategy over time while controlling for firm-specific characteristics. Cross-sectional comparison allows for an examination of a firm's relative performance within its industry while keeping industry-level characteristics constant. There are no absolute criteria for most ratios. The only exceptions are measurements of rates of return that may be compared to the investment's cost of capital. The rate of return on equity (ROE) can be compared against the cost of equity capital, for example, subject to accounting distortions.

The return on equity is the beginning point for a systematic study of a company's performance (ROE).

ROE = Net profit / Shareholders' equity

Because it shows how successfully managers are using the capital invested by the firm's shareholders to create returns, ROE is a complete indicator of a company's performance. Large publicly listed companies in Europe achieve ROEs of 8 to 10% on average over extended periods of time.



The connection between the firm's ROE and its cost of equity capital determines the value of its equity in the long run. That is, companies that are projected to earn ROEs greater than the cost of equity capital over the long term should have market values greater than book value, and vice versa.

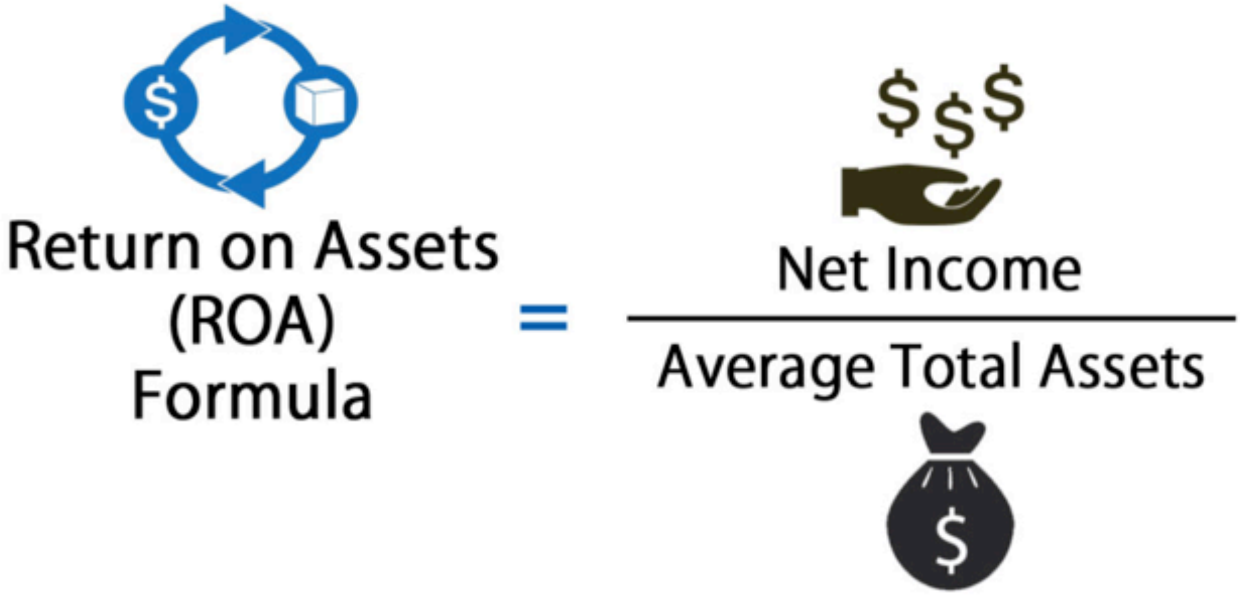
A comparison of ROE to cost of capital is important not only for determining the firm's worth, but also for forecasting future profitability. In the absence of significant impediments to entry, generating continuous supernormal profits will attract competitors. As a result, competitive pressures tend to move ROEs toward a ''normal" level - the cost of equity capital – over time. The cost of equity capital may thus be thought of as a benchmark for the ROE that would be seen in a long-run competitive equilibrium. Deviations from this standard occur for two main reasons. One is the industry circumstances and competitive strategy that cause a company to make abnormal (or abnormal) economic profits, at least in the near term. The second factor is accounting distortions.

The initial equity, ending equity, or an average of the two can all be used to calculate ROE. The average equity is conceptually acceptable, especially for quickly developing businesses. Most organizations, however, don't care about the computational decision as long as the analyst is consistent. As a result, most analysts in practice utilize ending balances for simplicity. This observation applies to all ratios presented in this chapter that have a flow variable (items in the income statement or cash flow statement) and a stock variable (items in the balance sheet).

Two variables influence a company's ROE: how profitably it utilizes its assets and the size of the firm's asset base in relation to shareholders' investment. ROE may be divided into return on assets (ROA) and a measure of financial leverage, the equity multiplier, to better understand the impact of these two elements.

ROE = ROA x Equity multiplier = (Net profit/Total assets) x (Total assets/Equity)

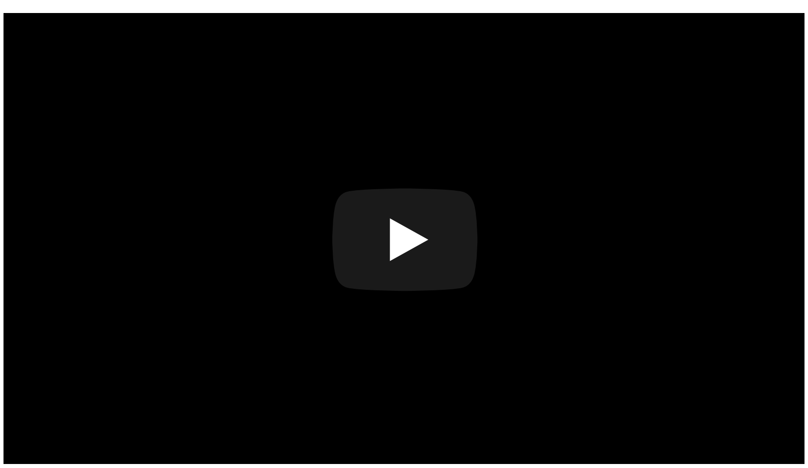
The return on assets (ROA) shows us how much profit a firm may make for every euro invested in assets. For each euro invested by its shareholders, the equity multiplier reflects how many euros of assets the company may deploy.



The ROA itself may be split into two components:

ROA = (Net profit/Sales) x (Sales/Total assets)

Net profit margin, also known as return on sales (ROS), is the ratio of net profit to sales; asset turnover is the ratio of sales to total assets. The profit margin ratio shows how much profit a firm may keep for every euro of sales it produces. Asset turnover refers to how many sales euros a company can earn for each euro invested in its assets.



Even though the previous methodology is commonly used in order to decompose a firm’s ROE, it poses several limitations. In the calculation of

ROA, the denominator includes the assets claimed by all capital providers of the firm, however the numerator includes only the earnings available to equity holders. Operating assets and investment assets, such as minority equity investments and surplus cash, are among the assets. In addition, net profit comprises earnings from operational and investing operations, as well as interest income and cost, both of which are the result of financing decisions. It's important to distinguish between these performance sources for at least two reasons:

1. The tools used to value operational assets differ from those used to value investment assets. Financial statements, in particular, include a wealth of information on the financial and risk implications of operating activities, allowing the analyst to approach the analysis and appraisal of such activities with confidence. In contrast, it is frequently difficult to determine what makes up investment assets and what drives their profitability from financial statements, forcing analysts to rely on shortcut techniques or a firm's own fair value disclosures to estimate the worth of such assets.
2. Operating, investing, and finance activities all contribute differently to a company's performance and value, and their relative importance varies substantially over time and among companies. By combining operational and investment assets, the impact of these investments on retailer performance is obscured. Furthermore, rising financial leverage can have both a direct and indirect negative impact on return on equity by raising a company's financial risk and borrowing costs. The equity multiplier indicates the direct effect of leverage, whereas the net profit margin shows the indirect effect.

Finally, the aforementioned financial leverage ratio ignores the reality that part of a company's obligations are essentially non-interest-bearing operational liabilities.

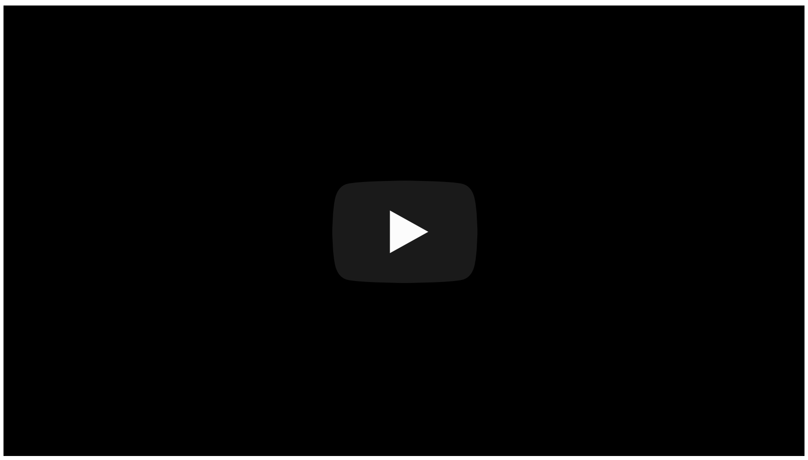
Cash Flow Analysis

Objectives:

- Students will be able to describe the concepts of cash flow analysis.
- Students will be able to explain how working capital applies to operations.
- Students will be able to define what a cash flow analysis model is.
- Students will be able to apply the concepts of the cash flow analysis model.

In their financial statements, all firms must provide a statement of cash flows. Firms categorize their cash flows into three areas in the reported cash flow statement: cash flow from operations, cash flow related to investments, and cash flow connected to financing activities. After paying for the cost of inputs and operations, cash flow from operations is the cash earned by the company through the sale of goods and services. The cash spent for capital expenditures, inter-corporate investments, acquisitions, and cash obtained from the sale of non-current assets is shown in the cash flow connected to investment operations.

The direct and indirect cash flow statement forms are used by businesses. The way they show cash flow from operational operations is the main distinction between the two forms. Operating cash receipts and disbursements are reported directly under the direct cash flow format, which is utilized by only a limited number of businesses in practice. Firms obtain their operational cash flows in the indirect format by making accrual adjustments to net profit. Many analysts and managers prefer the indirect style because it connects the cash flow statement to the income statement and balance sheet of the company.



Because revenues and costs are calculated on an accrual basis, net profit varies from operational cash flows. In net profit, there are two types of accruals. There are existing accruals such as credit sales and outstanding costs to begin with. Current accruals cause changes in a company's current assets and liabilities (such as trade receivables, inventory, and prepaid costs) (such as trade payables and current pro- visions). Non-current accruals, including as depreciation, deferred taxes, and equity income from unconsolidated subsidiaries, are the second kind of accruals in the income statement. Adjustments must be made for both types of accruals in order to calculate cash flow from operations from net profit. Adjustments must also be made for non-operating gains, such as earnings from asset sales, that are included in net profit.

The accrual adjustments that must be made to net profit in order to arrive at operational cash flows are expressly detailed in the indirect cash flow format.

Analysts should know how to generate an estimated indirect cash flow statement if a company utilizes the direct cash flow format. The first step is to determine a company's working capital from operations, which is defined as net profit adjusted for non-current accruals and profits on non-current asset sales. Non-current accruals like depreciation and deferred taxes, as well as non-operating profits, are generally included in the income statement or the notes to the financial statements. Making the necessary adjustments for current accruals connected to operations, the second step is to convert working capital from operations to cash flow from operations.

Examining changes in a company's current assets and current liabilities might provide information on current accruals. Operating accruals typically include changes in all current asset accounts save cash and cash equivalents, as well as changes in all current liability accounts except notes payable and the current part of non-current debt. The following formula may be used to compute cash from operations:

Working capital from operations

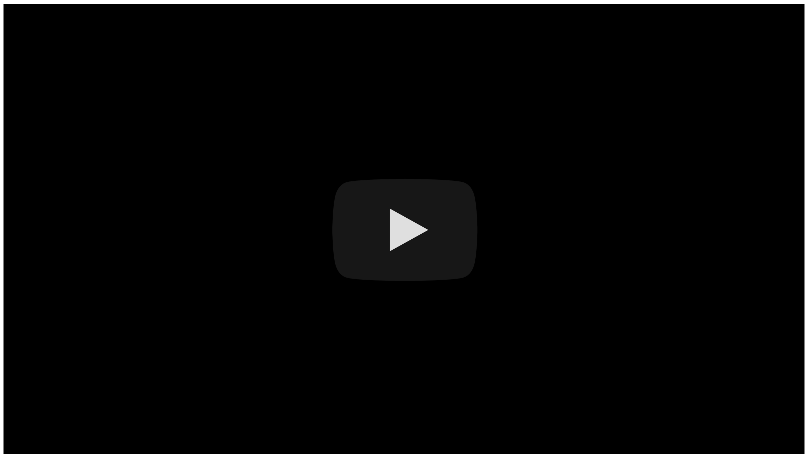
- Increase (or + decrease) in trade receivables

- Increase (or + decrease) in inventories

- Increase (or + decrease) in other current assets excluding cash and cash equivalents

+ Increase (or - decrease) in trade payables

+ Increase (or - decrease) in other current liabilities excluding debt.



Working capital from operations, after adjusting for changes in the balance sheet values of current assets and liabilities, is rarely equivalent to the operational cash flow shown in the direct cash flow statement. To match the operational cash flows in the two cash flow statements, the analyst must add a category of additional, unexplained accruals to the self-constructed indirect cash flow statement. This complexity occurs when events such as changes in consolidation or foreign currency exchange rate changes influence year-to-year variations in the balance sheet values of current assets and liabilities, but current accruals in the indirect cash flow statement are not.

To restate the cash flow data, analysts employ a variety of methods. They depict cash flow from operations in two stages, for example. Before operating working capital investments, the initial stage calculates cash flow from operations. The model does not include interest expense when calculating this cash flow. An analyst subtracts or adds three sorts of things from a firm's earnings before interest and taxes to arrive at this number:

- Subtract taxes paid plus (1 - tax rate) x interest paid, adjusted for the tax shield on interest payments. The tax shield adjustment ensures that the restated cash flow from operations is unaffected by the firm's financing arrangement.
- Non-operating profits or losses, such as those resulting from asset disposals or asset write-offs, should be added back since they are investment-related and will be evaluated later.

- Because they are non-cash operating expenses, add back non-current operational accruals like depreciation and deferred taxes.

A company's capacity to produce positive cash flow from operations is influenced by a number of factors. Healthy, stable businesses should be able to earn more income from their consumers than they spend on running costs. Growing businesses, on the other hand, may face negative operational cash flow if they invest heavily in R&D, advertising, and marketing, or in building an organization to support future growth. The way a company manages its working capital has an impact on whether or not it generates positive cash flow from operations. Cash flow is generally invested in operating working capital items such as accounts receivable, inventory, and accounts payable by companies in the early stages of their development. Firms' credit practices (trade receivables), payment policies (trade payables, prepaid costs, and allowances), and projected sales growth all influence net working capital investments (inventories). As a result, it's critical to consider a company's development plan, industry characteristics, and credit policies when assessing cash flow from operations after working capital.

The cash flow analysis model then concentrates on long-term investment cash flows. Capital expenditures, intercorporate investments, and mergers and acquisitions are all examples of these investments. After making operating working capital investments, any positive operating cash flow allows the company to pursue long-term growth possibilities. If the firm's operational cash flows after working capital investments are insufficient to sustain long-term investments, it will need to rely on outside borrowing to fund its expansion. Firms that can fund their development internally have less flexibility to undertake long-term investments. Being able to support expansion internally has both costs and rewards. Managers might utilize domestically produced free cash flow to support unproductive projects, which comes at a cost. If managers are compelled to rely on external capital providers, such inefficient capital expenditures are less likely. If it is difficult to convey the benefits of such investments to the capital markets, reliance on external capital markets may make it difficult for managers to make long-term hazardous investments.

Any extra cash flow following these long-term investments is accessible to both debt and equity holders as free cash flow. Interest and principle payments are two types of payments made to debt holders. Firms with negative free cash flow must borrow more money to satisfy their interest and debt repayment commitments, or reduce their working capital and long-term investments, or issue more stock. This is definitely a financially hazardous scenario for the company.

Cash flow available to stockholders after debt payments is free cash flow. Dividends and share repurchases are two types of payments made to equity holders. Companies that pay dividends despite negative free cash flow to stockholders are borrowing money to do so. While this may be viable in the near term, a company should not pay dividends to its stockholders unless it has a consistent positive free cash flow. Firms with a significant free cash flow after debt payments, on the other hand, face the danger of squandering that money on unproductive investments in order to seek growth for its own sake. As a result, an analyst should carefully analyze such companies' investment intentions.

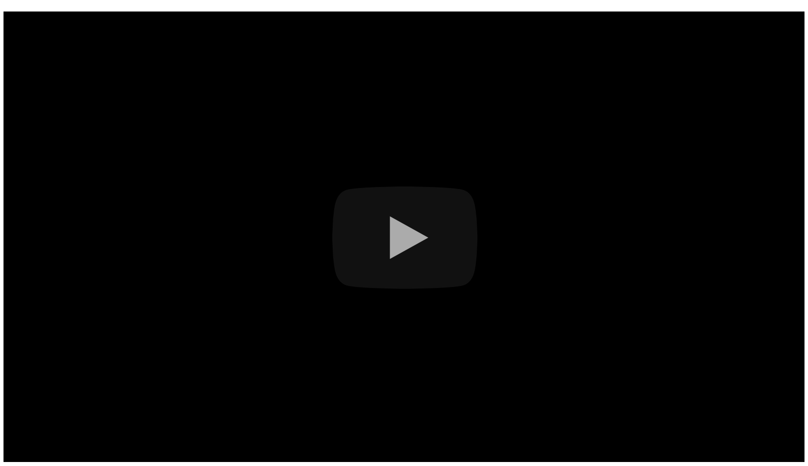
Fundamental Analysis

Objectives:

- Students will be able to define what fundamentals are.
- Students will be able to explains what a fundamental analysis is.
- Students will be able to differentiate between Macroeconomics and Microeconomics.
- Students will be able to explain how fundamental analysis relates to business.

Fundamentals provide a method to set the financial value of a company, security or currency and their subsequent financial valuation. They are include basic qualitative and quantitative information that contributes to the asset's financial or economic well-being. Fundamentals can be categorized into macroeconomic or microeconomic depending on their affect of the size of the financial entities. In business, profitability, revenue, assets, liabilities and growth potential are all considered fundamentals.

Understanding Fundamentals

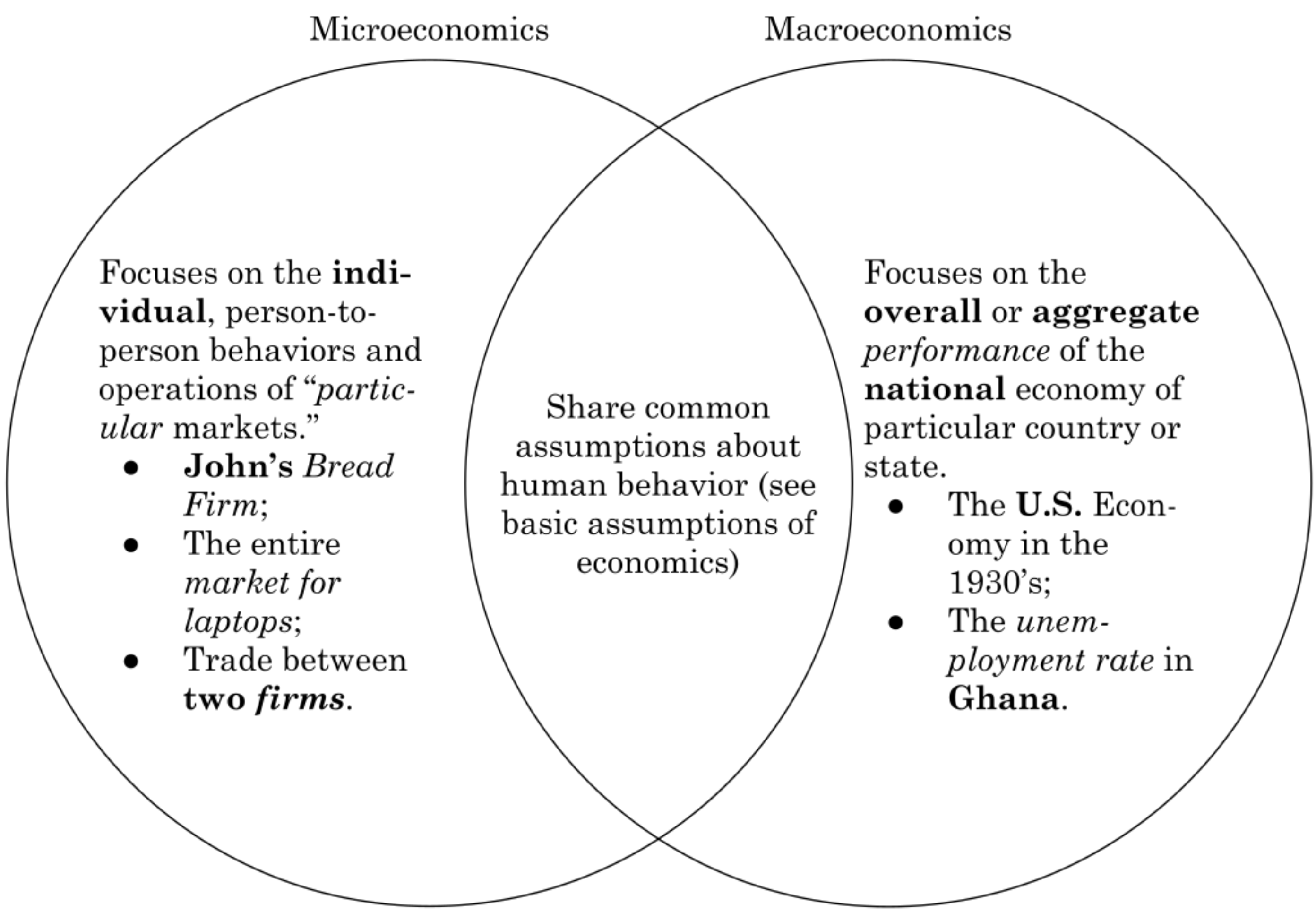


In business and economics, fundamentals are the primary characteristics and financial data imperative for determining stability and the health of an asset. Macroeconomics and Microeconomics can be included in this data.

Analysts and investors examine these fundamentals to develop an estimate to determine if the underlying asset is considered a worthwhile investment as well as if the valuation is fair in the market. Information like profitability, revenue, assets, liabilities and growth potential in businesses are considered fundamentals. To determine a company's feasibility of the investment, the use of fundamental analysis is considered.

National economies and currencies have a set of fundamentals that can be analyzed. Take for example, interest rates, GDP growth, trade balances and inflation levels as factors that are considered to be fundamentals of a nation's value.

Macroeconomic and Microeconomic Fundamentals



When talking of topics that affect an economy at large which may include unemployment statistics, supply & demand, growth and inflation, these are examples of Macroeconomic fundamentals. Such categories can be applied to the analysis of a large-scale economy or be related to an individual business activity to assess changes based on large influences within the economy.

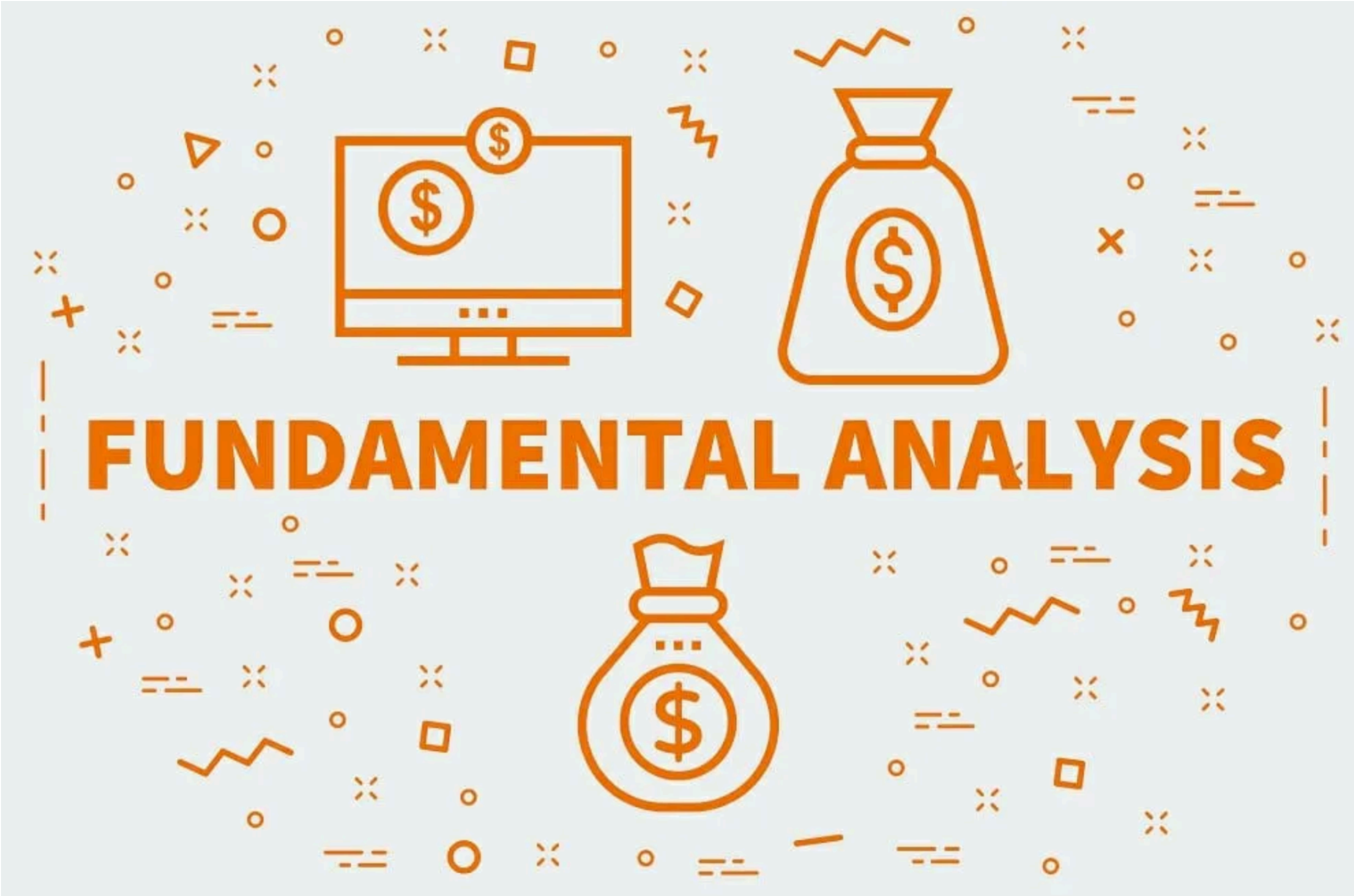
In contrast to macroeconomics, focusing on a smaller scale of activating with in segments is called microeconomics. The categories may be the same as its larger counterpart but the analysis is on a smaller and more concise practice. Consumer theory investigates how people spend within their particular budget restraints.

Fundamentals in Business

A business with strong fundamentals may be more likely to survive adverse events, like economic recessions or depressions, than one with weaker fundamentals. A company with little debt and sufficient cash is considered to have strong fundamentals.

Strong fundamentals suggest that a business has a viable framework or financial structure.By By looking at the economics of a business, including the overall management and the financial statements, investors are looking at a company's fundamentals. Conversely, those with weak fundamentals may have issues in the areas of debt obligation management, cost control, or overall organizational management. Not only do these data points show the health of the business, but they also indicate the probability of further growth. Also, strength may indicate less risk should an investor consider purchasing securities associated with the businesses mentioned.

Fundamental Analysis



Investors and financial analysts are interested in evaluating the fundamentals of a company to compare its economic position relative to its industry peers, to the broader market, or to itself over time. Fundamental analysis involves digging deep into a company's financial statements to extract its profit and growth potential, relative riskiness, and to ultimately decide if its shares are over, under, or fairly valued in the market.

Often fundamental analysis involves computing and analyzing ratios to make apples-to-apples comparisons. Some common fundamental analysis ratios are listed below.

- The debt-to-equity ratio (DE) measures how a company is financing its operations.
- The quick ratio measures the company’s ability to meet its short-term obligations.
- The degree of financial leverage (DFL) measures the stability or volatility of the earnings per share (EPS).

- The price-to-earnings (P/E) ratio compares investment to earnings dollars.
- The DuPont analysis looks at return on equity (ROE) by looking at asset use efficiency, operating efficiency, and financial leverage.

Fundamental analysis should be carried out with a holistic approach, utilizing several ratios and including a bottom-up as well as a top-down analysis to come to specific conclusions and actions.

Barra Risk Factor Analysis

Objectives:

- Student will be able to define the Barra Risk Factor Analysis.
- Student will be able to provide a basic understanding of how the Barra Risk Factor Analysis is used in regards to risk and investments.
- Students will be able to apply the Barra Risk Factor Analysis when provided with a scenario of requisite scenarios.

The Barra Risk Factor Analysis is a multi-factor model, created by Barra Inc., used to measure the overall risk associated with a security relative to the market. Barra Risk Factor Analysis incorporates over 40 data metrics, including earnings growth, share turnover and senior debt rating. The model then measures risk factors associated with three main components: industry risk, the risk from exposure to different investment themes and company-specific risk.

Understanding Barra Risk Factor Analysis

An element that investors and portfolio managers scrutinize when evaluating the markets or portfolios is investment risk. Identifying and measuring investment risk is one of the most important steps taken when deciding what assets to invest in. This is because the level of risk taken determines the level of return that an asset or portfolio of assets will have at the end of a trading cycle. Consequently, one of the most widely accepted financial principles is the tradeoff between risk and return.

One method that a portfolio manager might use to measure investment risk is evaluating the impact of a series of broad factors on the performance of various assets or securities. Using a factor model, the return-generating process for a security is driven by the presence of the various common fundamental factors and the asset's unique sensitivities to each factor. Since a few important factors can explain the risk and return expected on investment to a large degree, factor models can be used to evaluate how much of a portfolio's return is attributable to each common factor exposure. Factor models can be broken down into single-factor and multiple-factor models. One multi-factor model that can be used to measure portfolio risk is the Barra Risk Factor Analysis model.

The Barra Risk Factor Analysis was pioneered by Bar Rosenberg, founder of Barra Inc., and is discussed at length in Grinold and Kahn (2000), Conner et al (2010) and Cariño et al (2010). It incorporates a number of factors in its model that can be used to predict and control risk. The multi-factor risk model uses a number of key fundamental factors that represent the features of an investment. Some of these factors include yield, earnings growth, volatility, liquidity, momentum, size, price-earnings ratio, leverage, and growth; factors which are used to describe the risk or returns of a portfolio or asset by moving from quantitative, but unspecified, factors to readily identifiable fundamental characteristics.

The Barra Risk Factor Analysis model measures a security's relative risk with a single value-at-risk (VaR) number. This number represents a percentile rank between 0 and 100, with 0 being the least volatile and 100 being the most volatile, relative to the U.S. market. For instance, a security with a value-at-risk number of 80 is calculated to have a greater level of price volatility than 80% of securities in the market and its specific sector. So, if Amazon is assigned a VaR of 80, it means that its stock is more price volatile than 80% of the stock market or the sector in which the company operates.

Reading Material

Barra-Type Factor Structure:

Introduction to Financial Modeling

Objectives

- Students will be able to explain what a financial model is.
- Students will be able to describe what the output of a financial model is used for.
- Students will be able to explain what financial models mean to executives.

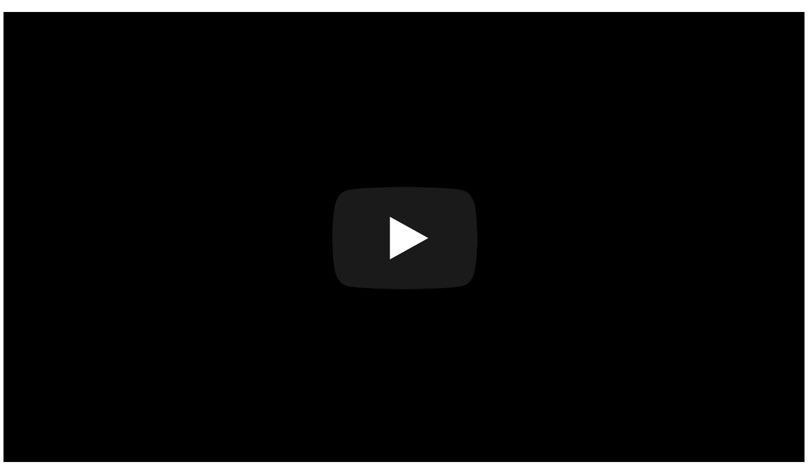
A financial model is a tool that forecasts a company's financial success in the future. The income statement, balance sheet, cash flow statement, and supporting schedules are generally used to make the projection, which is based on the company's previous performance.

2018 Monthly FINANCIAL STATEMENTS	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Cash Flow Statement												
Operating Cash Flow												
Net Earnings	2,474	11,791	21,075	26,713	28,227	26,543	24,401	25,209	52,749	61,839	70,146	79,323
Plus: Depreciation & Amortization	19,500	18,150	17,205	16,544	16,080	13,132	13,786	14,211	14,487	14,667	14,783	14,859
Less: Changes in Working Capital	9,003	1,702	775	903	827	3,175	5,062	5,768	(2,613)	2,041	2,664	2,931
Cash from Operations	**12,971**	**28,239**	**37,505**	**42,354**	**43,480**	**36,500**	**33,125**	**33,652**	**69,849**	**74,464**	**82,265**	**91,251**
Investing Cash Flow												
Investments in Property & Equipment	15,000	15,000	15,000	15,000	15,000	15,000	15,000	15,000	15,000	15,000	15,000	15,000
Cash from Investing	**15,000**	**15,000**	**15,000**	**15,000**	**15,000**	**15,000**	**15,000**	**15,000**	**15,000**	**15,000**	**15,000**	**15,000**
Financing Cash Flow												
Issuance (repayment) of debt	-	-	(20,000)	-	-	-	-	(20,000)	-	-	-	-
Issuance (repayment) of equity	70,000	-	-	-	-	-	-	-	-	-	-	-
Cash from Financing	**70,000**	**-**	**(20,000)**	**-**	**-**	**-**	**-**	**(20,000)**	**-**	**-**	**-**	**-**
Net Increase (decrease) in Cash	67,971	13,239	2,505	27,354	28,480	21,500	18,125	(1,348)	54,849	59,464	67,265	76,251
Opening Cash Balance	-	67,971	81,210	83,715	111,069	139,550	161,050	179,175	177,827	232,676	292,140	359,405
Closing Cash Balance	**67,971**	**81,210**	**83,715**	**111,069**	**139,550**	**161,050**	**179,175**	**177,827**	**232,676**	**292,140**	**359,405**	**435,657**
Charts and Graphs												
Revenue	102,007	118,086	131,345	142,341	150,772	165,849	182,434	200,678	220,745	242,820	267,102	293,812
Gross Profit Margin (%)	62%	59%	63%	63%	62%	58%	53%	50%	64%	65%	65%	65%
Operating Cash Flow	12,971	28,239	37,505	42,354	43,480	36,500	33,125	33,652	69,849	74,464	82,265	91,251
Investing Cash Flow	(15,000)	(15,000)	(15,000)	(15,000)	(15,000)	(15,000)	(15,000)	(15,000)	(15,000)	(15,000)	(15,000)	(15,000)
Financing Cash Flow	70,000	-	(20,000)	-	-	-	-	(20,000)	-	-	-	-

Whether inside or outside the firm, the output of a financial model is utilized for decision-making and financial analysis. Financial models will be used by executives inside a firm to make choices about:

- Capitalization (debt and/or equity)
- Buying (or selling) companies and/or assets
- Expanding the business (for example, by opening more stores or entering new markets).
- Assets and business units are being sold or divested.
- Planning and budgeting (for the years ahead)
- Allocation of capital (priority of which projects to invest in)
- Determining the worth of a company

Practice is the most effective approach to learn financial modeling. To become an expert at developing a financial model, you'll need years of expertise and a lot of practice. Reading equity study papers may be a good method to practice since you can compare your results to them. Using a mature company's past financials to create a flat-line model into the future and compute the net present value per share is one of the greatest methods to practice. This should be comparable to the current share price or stock research report target pricing.



Types of Financial Models

Objectives:

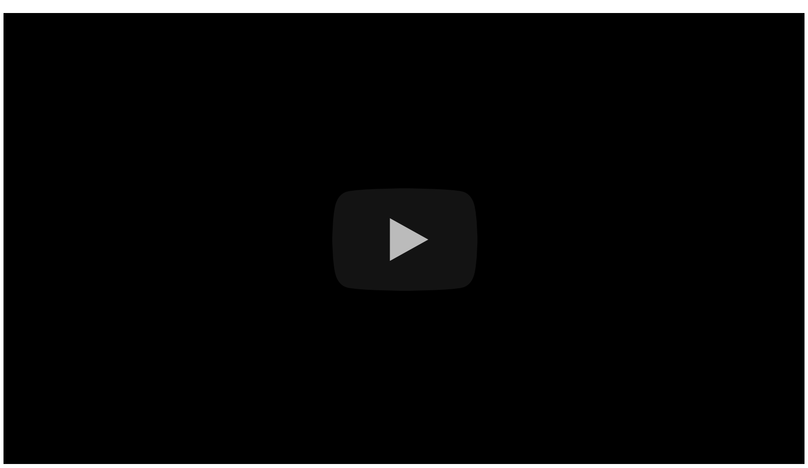
- Students will be able to identify the different types of financial models.
- Students will be able to describe the different phases of building a three-statement model.
- Students will be able to detail the benefits of using a single worksheet model.
- Students will become familiar with forecasting from a financial model.
- Students will become familiar with a discounted cash flow model.
- Students will identify the various forecasting involved in a discounted cash flow model.

Financial models come in a variety of shapes and sizes. Financial modeling experts utilize a variety of models in corporate finance, and we'll go through some of the more prevalent ones.

3 Statement Model

An integrated 3-statement model

A three-statement model combines the income, balance, and cash flow statements into a single dynamically linked financial model. More complex financial models, such as discounted cash flow (DCF) models, merger models, leveraged buyout (LBO) models, and other forms of financial models, are developed on top of 3 statement models.



A **three-statement model** can be structured in one of two ways: single worksheet or multi-worksheet. While both techniques are valid, CFI strongly advises adopting a single worksheet structure (with grouping) for the following reasons.

The following are some of the benefits of using a single worksheet model:

- It's easier to navigate (you don't have to switch tabs)
- There's a lower chance of formulae being mixed up (all time periods are in the same column)
- The usage of grouping cells helps to keep things more orderly.
- Allow greater space for multi-business enterprises to be consolidated.

Building a three-statement model entails numerous phases, including:

- Enter historical financial data

We take the company's historical financial data and either download, type, or paste it into e.g., Excel in this stage. Once you have the data in Excel, you'll need to conduct some basic formatting to make it easier to understand and follow the structure you want for your model. The historical information is inputted in a blue font color beneath the historical time periods, as shown in the picture below.

- Determine the forecast assumptions

We can start calculating some measures to analyze the company's past performance now that we have the historical financial data in Excel and in an easy-to-use format. We must compute revenue growth, margins, capital expenditures, and working capital terms, among other things (such as accounts payable, inventory, and accounts receivable). The assumptions section, which drives the prediction, is shown below as an example.

- Forecast the income statement

After you've established your assumptions, you can begin projecting the income statement, starting with sales and working your way down to EBITDA (Earnings Before Interest Taxes Depreciation and Amortization). We'll need to build support schedules for items like capital assets and finance activities at that time.

- Forecast capital assets

Before we can conclude the income statement in the model, we must predict capital assets such as Property, Plant, and Equipment (PP&E). To do so, we start with the previous period's closing balance, add any capital expenditures, subtract depreciation, and arrive at the current period's closing balance. Depreciation may be computed in a number of different methods, including straight line, decreasing balance, and percentage of income.

- Forecast financing activities

The next step is to create a debt schedule in order to calculate interest expenditure on the income statement. We take the previous period's closing balance, add any gains or losses in principle, and arrive at the closing balance, similar to the part before. The interest expenditure can be computed based on the outstanding debt's starting balance, closing balance, or average balance. Alternatively, if one is available, a comprehensive interest payment schedule might be followed.

- Forecast the balance sheet

Except for the cash balance, which will be the last step, it is easy to complete the balance sheet in our three-statement model at this point. The forecasting of working capital items is based on assumptions about typical days payable and receivable, as well as inventory turns. Capital assets (PP&E, for example) and debt amounts are derived from the timetable above.

- Fill in the blanks on the cash flow statement.

We can build the cash flow statement and finish our three-statement model in Excel now that the balance sheet is complete (except for cash). This section is essentially completed by simply linking to items that have already been calculated in the model above. Each of the three primary parts must be completed: cash from operations, cash from investment, and cash from borrowing.

Discounted Cash Flow (DCF) Model

The Weighted Average Cost of Capital (WACC) of a company indicates the needed rate of return that its investors anticipate. As a result, it's also known as a company's opportunity cost, implying that if they can't find a better rate of return elsewhere, they should buy back their own stock.

A firm is said to be “creating value” if it obtains rates of return that are higher than its cost of capital (their hurdle rate). They are “destroying value” if their rate of return is less than their cost of capital.

The needed rate of return for investors (as described above) is usually related to the investment's risk (using the Capital Asset Pricing Model). As a result, the greater the needed rate of return and the higher the cost of capital, the riskier the venture. The more distant the cash flows, the riskier they are, and hence the more they must be discounted.

Cash Flow Forecast in a DCF Model

This is a vast subject and predicting a company's performance is an art form. In simple terms, a financial analyst's duty is to provide the best educated prediction possible about how each of a company's drivers will affect its future performance. For additional information, see our guide to assumptions and forecasts.

Except in resource or long-life sectors like mining, oil and gas, and infrastructure, where engineering reports may be utilized to construct a long-term “life of resource” projection, a DCF model forecast typically goes out five years.

1. Revenue forecasting

There are various approaches to developing a revenue projection, but they may be divided into two groups: growth-based and driver-based. A growth-based projection is simpler and more appropriate for stable, established firms that can utilize a simple year-over-year growth rate. This is adequate for many DCF models. A prediction based on drivers is more comprehensive and difficult to create. It necessitates breaking down revenue into its different drivers, which include price, volume, goods, consumers, market share, and external variables. To identify the link between underlying drivers and top-line revenue growth, regression analysis is frequently employed as part of a driver-based prediction.

2. Expense forecasting

A thorough and granular expenditure projection may be created, or a basic year-over-year comparison can be performed. The most thorough technique is known as a Zero-Based Budget, and it entails starting from zero with no regard for what was spent the previous year. Every department in the firm is often required to justify every cost they have based on activity. This method is frequently utilized in cost-cutting situations or when financial controls are being implemented. It can only be done by corporate management, not by outsiders like investment bankers or stock research analysts, because it is only practicable to do it internally.

3. Capital asset forecasting and working capital fluctuations

After you've completed most of the income statement, it's time to predict capital assets. The most thorough technique is to build a distinct timetable for each of the key capital assets in the DCF model and then combine them into a total plan. There will be multiple lines on each capital asset schedule: opening balance, depreciation, dispositions, and closing balance. Working capital changes, which include accounts receivable, payables, and inventories, must be computed and added or removed based on their financial impact.

4. Capital structure forecasting

The method you construct this part will be mainly determined by the sort of DCF model you're creating. The most typical strategy is to simply maintain the company's present capital structure, assuming no significant changes other than known factors like debt maturity. This portion of the DCF model isn't really essential because we're utilizing unlevered free cash flow. However, if you're looking at things from the standpoint of a stock investor or equities research analyst, it's critical. Enterprise value is more significant for

M&A deals, when the complete business is acquired or sold, therefore investment bankers generally focus on it.

5. Terminal Value

A DCF model's terminal value is extremely significant. It frequently accounts for more than half of the business's net present value, especially if the projection term is shorter than five years. The perpetual growth rate technique and the exit multiple approach are two methods for calculating the terminal value.

6. Cash Flow Timing

In a DCF model, it's critical to pay particular attention to the timing of cash flows because not all time periods are created equal. At the start of the model, there is typically a "stub phase" where just a fraction of the year's cash flow is received. Furthermore, the cash outflow (making the real investment) takes a long time before the stub is received.

7. Enterprise value and DCF

The NPV that you arrive at when creating a DCF model using unlevered free cash flow is always the enterprise value (EV) of the firm. This is what you'll need if you want to evaluate the entire company or compare it to comparable firms without taking their capital structures into consideration (i.e., an apples-to-apples comparison). The focus will be on enterprise value in most investment banking deals.

8. Equity value calculated using DCF

Take the net present value (NPV) of the unlevered free cash flow and adjust it for cash and equivalents, debt, and any minority stake to get the equity value of the company. You'll get the equity value, which you'll divide by the number of shares to get the share price. This method is more popular among institutional investors and equities research analysts, who are both interested in purchasing or selling stocks.

Building a Financial Model

Objectives:

- Students will be able to carry over their knowledge of a financial model to apply to this lesson.
- Students will become familiar with the steps necessary to build the financial model.
- Students will be able to run a stress test and an audit once they have built their financial model.

It's crucial to lay up a financial model in a logical, easy-to-understand manner. This usually entails creating the entire model on a single worksheet and then grouping it into parts. This makes it simple to extend and contract the model, as well as move it about. The process of financial modeling is iterative. You must chip away at various portions until you are ultimately able to connect them altogether.

1. Preliminary findings and assumptions

Every financial model begins with a company's past performance. You start by obtaining three years of financial information and entering them into Excel to create the financial model. Then, for the historical period, you reverse engineer the assumptions by calculating things like revenue growth rate, gross margins, variable expenses, fixed costs, AR days, inventory days, and AP days, to mention a few. From there, you may use hard-codes to fill up the forecast period's assumptions.

2. Begin income statement

With the forecast assumptions in place, you can compute sales, COGS, gross profit, and operating expenditures all the way down to EBITDA at the top of the income statement. Calculating depreciation, amortization, interest, and taxes will have to wait.

XYZ Corporation									
Income Statement									
For the year ended December 31,2012									
Revenues									
	Net Sales			$65,000.00					
	Dividend Revenue			$ 5,000.00					
	Total Revenues				$70,000.00				
Expenses									
	Cost of Goods Sold			$15,000.00					
	Selling Expenses			$ 4,500.00					
	Administrative Expenses			$ 3,500.00					
	Income Tax Expense			$ 4,500.00					
	Total Expenses				$27,500.00				
	Net Income				$42,500.00				
	Earnings Per Share				$ 1.74				

3. Begin balance sheet

You may begin filling up the balance sheet now that the top of the income statement is complete. Begin by computing the revenue and COGS functions of accounts receivable and inventory, as well as the AR days and inventory days assumptions. Fill in the accounts payable section, which is based on COGS and AP days.

INCOME STATEMENT FOR YEAR

Sales Revenue	$ 52,000
Cost of Goods Sold Expense	$ (33,800)
Selling, General, and Administrative Expenses	$ (12,480)
Depreciation Expense	$ (785)
Interest Expense	$ (545)
Income Tax Expense	$ (1,748)
Net Income	$ 2,642

Assuming the year-end inventory of goods awaiting sale equals 13 weeks of annual cost of goods sold the ending balance of inventory is:

13/52 × $33,800 = $8,450

BALANCE SHEET AT YEAR-END

ASSETS	
Cash	$ 3,265
Accounts Receivable	$ 5,000
Inventory	$ 8,450
Prepaid Expenses	$ 960
Property, Plant, and Equipment	$ 16,500
Accumulated Depreciation	$ (4,250)
Intangible Assets	$ 5,575
Total Assets	$ 35,500

LIABILITIES AND STOCKHOLDERS' EQUITY	
Accounts Payable	$ 3,320
Accrued Expenses Payable	$ 1,515
Income Tax Payable	$ 165
Short-Term Notes Payable	$ 3,125
Long-Term Notes Payable	$ 4,250
Capital Stock	$ 8,125
Retained Earnings	$ 15,000
Total Liabilities and Stockholders' Equity	$ 35,500

4. Create the ancillary schedules

You must establish a schedule for capital assets, such as PP&E, as well as debt and interest, before completing the income statement and balance sheet. The PP&E schedule will increase capital expenditures and remove depreciation from the historical period. In terms of the debt schedule, it will also use past data to add debt growth and remove repayments. The average debt balance will be used to calculate interest.

Capital Assets - PP&E Schedule	2016	2017	2018	2019	2020	2021	2022
Opening Balance							
Technology	0	240,000	220,000	190,000	510,000	370,000	1,040,000
Property & Equipment	0	160,000	160,000	150,000	130,000	220,000	230,000
Total	0	400,000	380,000	340,000	640,000	590,000	1,270,000
Capital Expenditures							
Technology	300,000	50,000	50,000	500,000	50,000	1,000,000	100,000
Property & Equipment	200,000	50,000	50,000	50,000	200,000	100,000	500,000
Total	500,000	100,000	100,000	550,000	250,000	1,100,000	600,000
Depreciation							
Technology							
2016	60,000	60,000	60,000	60,000	60,000	0	0
2017		10,000	10,000	10,000	10,000	10,000	0
2018			10,000	10,000	10,000	10,000	10,000
2019				100,000	100,000	100,000	100,000
2020					10,000	10,000	10,000
2021						200,000	200,000
2022							20,000
Subtotal	60,000	70,000	80,000	180,000	190,000	330,000	340,000
Property & Equipment							
2016	40,000	40,000	40,000	40,000	40,000	0	0
2017		10,000	10,000	10,000	10,000	10,000	0
2018			10,000	10,000	10,000	10,000	10,000
2019				10,000	10,000	10,000	10,000
2020					40,000	40,000	40,000
2021						20,000	20,000
2022							100,000
Subtotal	40,000	50,000	60,000	70,000	110,000	90,000	180,000
Total Depreciation	100,000	120,000	140,000	250,000	300,000	420,000	520,000
Closing Balance							
Technology	240,000	220,000	190,000	510,000	370,000	1,040,000	800,000
Property & Equipment	160,000	160,000	150,000	130,000	220,000	230,000	550,000
Total	400,000	380,000	340,000	640,000	590,000	1,270,000	1,350,000

5. Make a profit & loss statement and a balance sheet

The income statement and balance sheet are completed with the information from the accompanying schedules. Link depreciation to the PP&E schedule and interest to the debt schedule on the income statement. You may compute profits before taxes, taxes, and net income from there. Connect the closing PP&E balance and closing debt balance from the schedules on the balance sheet. Pulling forward last year's ending amount, adding net income and capital raised, and deducting dividends or shares repurchased will give you shareholder's equity.

Profit and loss account for the year ended 30 April 2011

	Notes	2011 £	2010 £
Turnover	2	384,821	240,350
Cost of sales		89,965	44,942
Gross profit		294,856	195,408
Administrative expenses		19,829	36,628
		19,829	36,628
Operating profit	3	275,027	158,780
Other interest receivable and similar income		-	103
Profit on ordinary activities before taxation		275,027	158,883
Taxation on profit on ordinary activities	5	57,059	33,267
Profit for the financial year		217,968	125,616

6. Create a cash flow statement

After you've completed the income statement and balance sheet, you may use the reconciliation technique to create the cash flow statement. To calculate cash from operations, start with net income, subtract depreciation, and account for changes in non-cash working capital. Cash used for investing is a function of capital expenditures in the PP&E schedule, while cash used for financing is a result of the assumptions made regarding debt and equity financing.

Sample Corporation
Statement of Cash Flows
Year Ended December 31, 2020

Cash flows from operating activities	$ xxx
Cash flows from investing activities	xxx
Cash flows from financing activities	xxx
Net increase (decrease) in cash	xxx
Cash at the beginning of the year	xxx
Cash at the end of the year	$ xxx

7. Conduct a DCF analysis

After you've finished the three-statement model, you'll need to compute free cash flow and do a company appraisal. At the firm's cost of capital, the business's free cash flow is discounted back to today (its opportunity cost or required rate of return). We have a comprehensive set of courses that cover all the aforementioned processes in detail, with examples, templates, and step-by-step instructions.

	Actual				Forecast period					CAGR	CAGR
	2014A	2015A	2016A	2017A	2018E	2019E	2020E	2021E	2022E	2014-2017A	2018-2022E
Net sales	2 955	3 568	4 102	4 663	5 036	5 388	5 711	5 997	6 237	*16,4%*	*5,5%*
growth, %		*20,7%*	*15,0%*	*13,7%*	*8,0%*	*7,0%*	*6,0%*	*5,0%*	*4,0%*		
COGS	-2 098	-2 516	-2 831	-3 310	-3 544	-3 792	-4 019	-4 220	-4 389	16,4%	5,5%
Gross profit	**857**	**1 053**	**1 272**	**1 352**	**1 492**	**1 596**	**1 692**	**1 777**	**1 848**	**16,4%**	**5,5%**
margin, %	*29,0%*	*29,5%*	*31,0%*	*29,0%*	*29,6%*	*29,6%*	*29,6%*	*29,6%*	*29,6%*		
OPEX	-180	-200	-210	-215	-224	-232	-240	-249	-257	6,1%	3,5%
growth, %		*11,1%*	*5,0%*	*2,4%*	*4,0%*	*3,8%*	*3,6%*	*3,4%*	*3,3%*		
in % of net sales	*6,1%*	*5,6%*	*5,1%*	*4,6%*	*4,4%*	*4,3%*	*4,2%*	*4,1%*	*4,1%*		
EBITDA	**677**	**853**	**1 062**	**1 137**	**1 268**	**1 364**	**1 452**	**1 528**	**1 591**	***18,9%***	***5,8%***
margin, %	*22,9%*	*23,9%*	*25,9%*	*24,4%*	*25,2%*	*25,3%*	*25,4%*	*25,5%*	*25,5%*		
Depreciation	-49	-63	-75	-84	-88	-95	-100	-105	-110	19,8%	5,5%
in % of net sales	*1,6%*	*1,8%*	*1,8%*	*1,8%*	*1,8%*	*1,8%*	*1,8%*	*1,8%*	*1,8%*		
EBIT	**628**	**790**	**987**	**1 053**	**1 180**	**1 270**	**1 351**	**1 423**	**1 481**	***18,8%***	***5,9%***
Tax (30%)	-119	-138	-151	-164	-354	-381	-405	-427	-444	11,4%	5,9%
Capex		-79	-41	-169	-115	-123	-130	-136	-142	n.a.	0
in % of net sales		*2,2%*	*1,0%*	*3,6%*	*2,3%*	*2,3%*	*2,3%*	*2,3%*	*2,3%*		
Increase/Decrease in NWC		-25	-5	-2	-15	-14	-13	-11	-9		
Unlevered Free Cash Flow		**611**	**865**	**802**	**785**	**847**	**904**	**954**	**995**		

DCF-valuation	
Enterprise value ("EV")	**11 012**
Equity value ("market cap")	10 812
Price per share	1,08

Implied multiples	**2017A**	**2018E**	**2019E**	**2020E**	**2021E**
Sales	2,4x	2,2x	2,0x	1,9x	1,8x
EBITDA	9,7x	8,7x	8,1x	7,6x	7,2x
EBIT	10,5x	9,3x	8,7x	8,1x	7,7x

8. Include possibilities and sensitivity analysis

After you've finished with the DCF analysis and valuation portions, it's time to add sensitivity analysis and scenarios to the model. The goal of this study is to see how much changes in underlying assumptions will affect the company's worth (or some other statistic). This is particularly useful for determining the risk of an investment or for business planning (e.g., does the company need to seek money if sales volume declines by x%?).

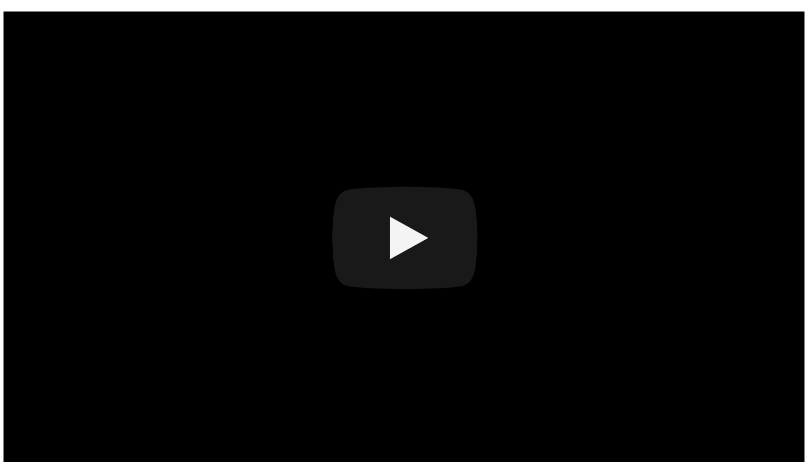
		Opportunistic		Disease Register		
	Scenarios	Mean cost/ patient compl. PACP (SD)	% change compared to base case	Mean cost/ patient compl. PACP (SD)	% change compared to base case	Differences in mean cost across delivery models (p)$^{+}$
0	Base case (Figure 3a)	£53.22 (7.82)	–	£190.84 (38.98)	–	£137.62** (0.047)
1	National rollout of 'Let's get Moving' resource booklet	£20.58 (3.52)	-61.33%	£155.47 (35.18)	-18.53%	£134.89** (0.0401)
2	All consultations delivered by healthcare assistant	£44.94 (6.50)	-15.56%	£128.29 (23.74)	-32.78%	£83.35** (0.0451)
3	All support activities delivered by receptionist (NHS pay band 2)	£52.68 (7.81)	-1.01%	£178.29 (35.50)	-6.58%	£125.61** (0.0466)
4	Altering variability factors 1 to 3 simultaneously (Figure 3b)	£11.76 (1.20)	-77.9%	£80.36 (16.78)	-57.89%	£68.60** (0.0305)

9. Create graphs and charts

The ability to clearly communicate results is what distinguishes excellent financial analysts from outstanding ones. Charts and graphs are the most efficient method to display the findings of a financial model, which we go over in depth in our advanced Excel course as well as many of the specific financial modeling courses. Because most executives don't have the time or patience to investigate the model's inner workings, charts are far more useful.

10. Run the model through a stress test and an audit

Your job does not end after the model is completed. Then, to determine if the model responds as predicted, start stress-testing severe situations. It's also critical to utilize the auditing tools presented in our financial modeling fundamentals course to ensure that the data is correct and that all of the formulae are operating properly.



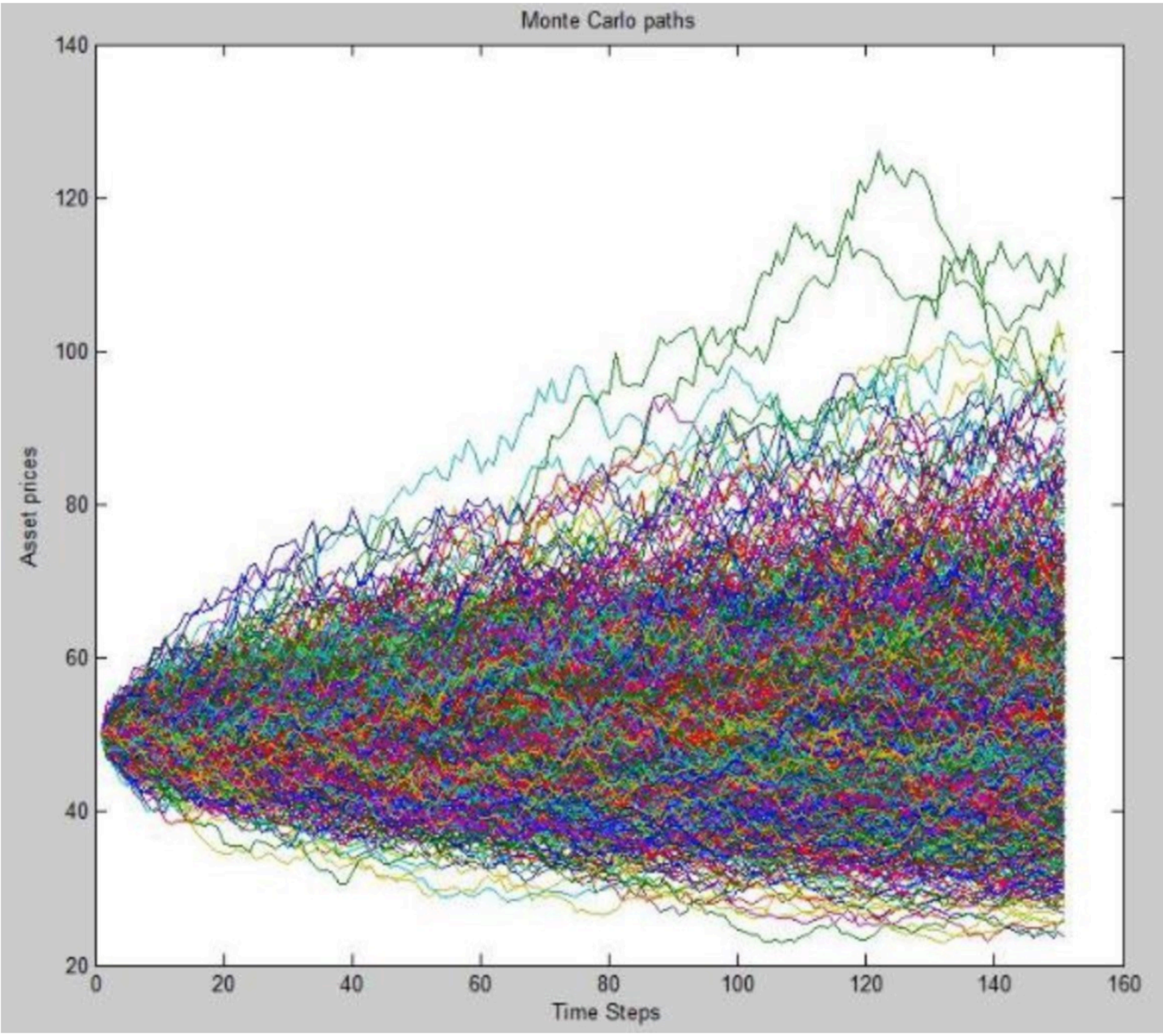
Introduction to Monte Carlo Simulations

Objectives:

- Students will be able to explain what the Monte Carlo simulation is.
- Students will be able to describe the importance of the Monte Carlo simulation.

Monte Carlo simulation most often refers to a computerized mathematical technique that allows people to account for risk in quantitative analysis and decision-making

The first occurrence of the Monte Carlo simulation method may be traced back to 1944. This approach has been subjected to several interpretations and definitions. Thus, we can conclude that it has undergone a lengthy evolution and development process. The method's ability to produce long sequences of random numbers was an early concern. In the beginning, pseudo-random numbers were employed, but as computer technology advanced, this barrier was removed.

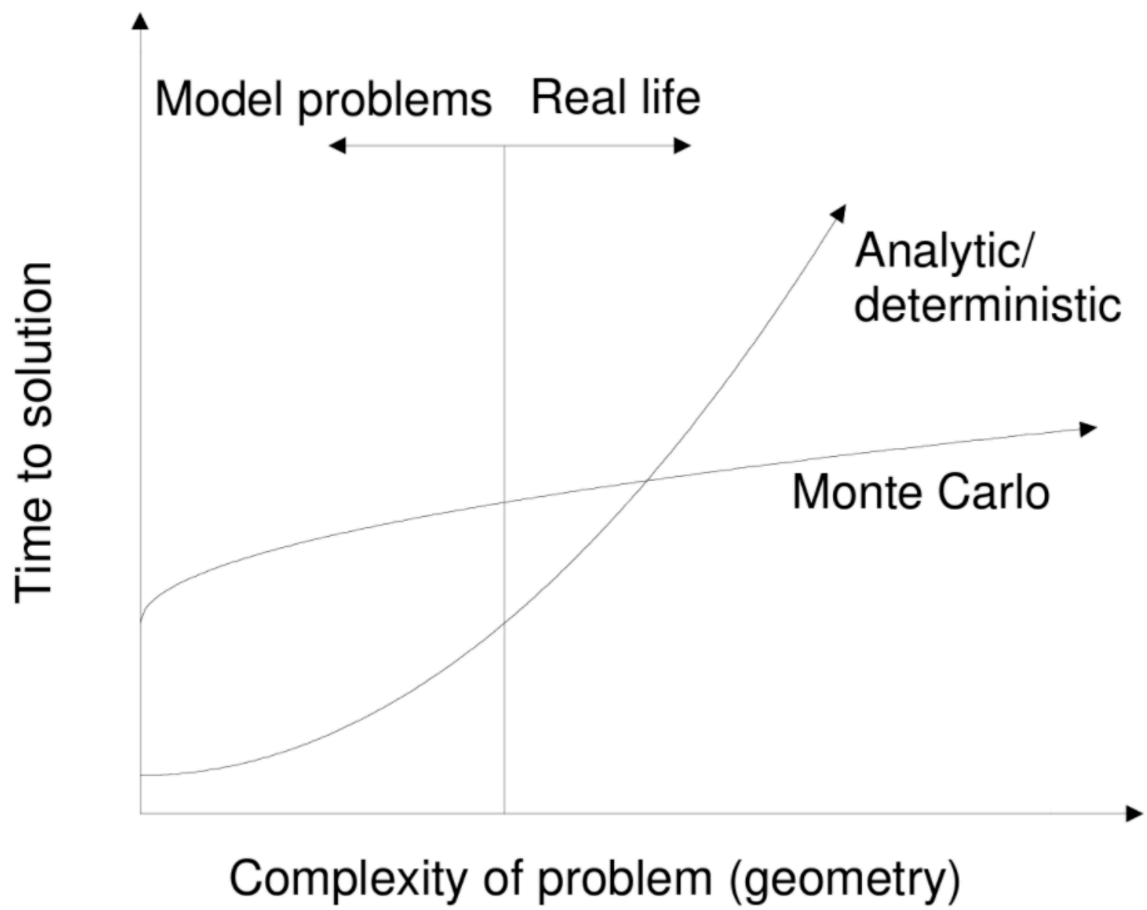


Cost Estimating Uncertainty Using Monte Carlo Techniques, published by Paul F. Dienemann in 1966 as part of a research project performed by the RAND Corporation for the US military, is one of the most important publications on the Monte Carlo approach in investment project selection. The purpose of this study was to explore how to choose a project depending on its cost. The author stressed that a single deterministic number is not a suitable selection indication, and that we need stochastic factors such as average, standard deviation, asymmetry, and others to make the best project selection decision.

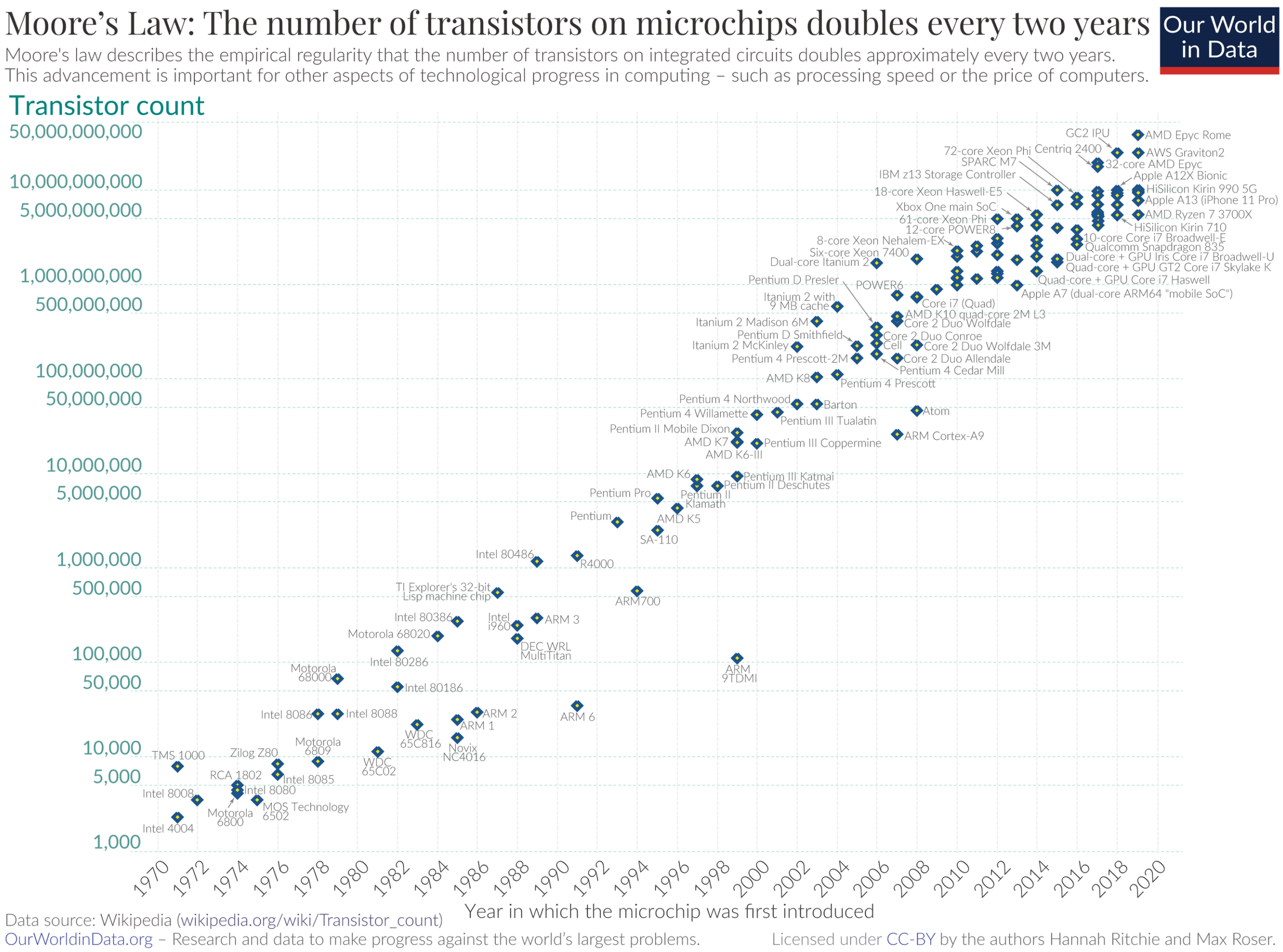
There would be considerable motive to invent Monte Carlo if it did not exist.

As previously stated, the trinity of measurement, theory, and Monte Carlo is essential to the output of both basic and applied research. Monte Carlo is sometimes viewed as a “rival” to other macroscopic computation methods, which we shall refer to as deterministic and/or analytic approaches. Although supporters of either technique might get rabid in their discussions, a scientist should first consider, "What do I want to accomplish?" and then, "What is the most effective way to achieve it?" The right answer will be “Deterministic” at times and “Monte Carlo” at other times.

However, there are two unavoidable facts. The first is that macroscopic theory, particularly transport theory, gives a wealth of information and enables for the development of sophisticated intuition about how macroscopic particle fields should behave. Monte Carlo will have a hard time competing with this. Monte Carloists are quite similar to experimentalists when it comes to finding the characteristics of macroscopic field behavior. Without theory to guide them, the process of discovery is trial and error, with occasional great intuition thrown in for good measure. When it comes to the difficulty of an issue, however, Monte Carlo approaches grow more beneficial as the complexity of the problem increases, regardless of how that is assessed.



Another unavoidable truth is that computers are becoming faster and less expensive at an exponential rate. Moore's Law is the name given to this phenomenon. The subject of when this exponential increase in computer performance will come to an end has sparked some heated discussion.



There are two methods for increasing speed. Computer circuits may be made smaller and smaller as technology develops, and signal movement within a chip takes less time. Smaller chips can also be put closer together, resulting in shorter interchip communication times. One of the issues with smaller sizes is that heat becomes an issue. This is addressed by running these circuits at lower voltages and putting these chips in sophisticated heat-dissipating assemblies, some of which have cooling fans installed directly on them. The "quantum limit" is another issue with tiny sizes. The state of a switch can grow so tiny that it is no longer well-defined (as in the classical example), and there is a risk that a switch, once thrown, would spontaneously reverse, generating undesired effects. Another advantage of compact size is that more circuitries may be packed into the same silicon real estate, allowing for the implementation of more sophisticated signal processing algorithms. Furthermore, ongoing study into the design of these algorithms is leading in more efficient processing per transistor. All of these factors combine to produce the exponential rise in computer speed per unit cost that we witness today.

Other doubters claim that market pressures aren't in favor of faster, less expensive computers. Fast computing has historically been driven by the demand for it in science, major business, and the military. The attractiveness of personal computers to the home market and their accessibility to small businesses are driving their rise. The personal computer has been so successful that the mainframe computer business has been pushed into niche industries. Some believe that consumers, particularly in home markets, will eventually stop driving demand so hard. What is the minimum speed need for a home computer? is a common comment made from this viewpoint. However, because applications often evolve to keep up with new technology, this claim may be unfounded. In the housing market, “keeping up with the Joneses” is still an issue.

Another advantage of Monte Carlo is that it uses a minimal quantity of data and a maximum number of floating-point operations. Maximum data and minimum floating-point operation techniques are frequently used in deterministic computations. Because communication bottlenecks, whether from the CPU to cache memory, cache memory to main memory, or main memory to large storage devices (typically disk), are frequently the cause of data processing bottlenecks, modern computer architecture favors the Monte Carlo model, which emphasizes iteration and minimizes data storage. Monte Carlo is just another weapon in the theorist's or experimentalist's arsenal. The significance of analytical progress cannot be overstated.

Because of the minimal computing work required in comparison to the difficulty of the issues that may be addressed, this approach is now useful for solving a wide range of problems with little effort. The Monte Carlo approach uses a random uniformly distributed number generator in the [0, 1] interval to produce fake values for a probabilistic variable, as well as the cumulative distribution function associated with these stochastic variables.

Economic decision simulation may be used to solve a variety of problems involving operational rules, policies, and procedures, such as those involving choice adaptation, decision control, and pricing policy. The application of simulation techniques is not, in reality, a decision-making process. In order to reach the goal, solving issues using simulation approaches necessitates the employment of interactive algorithms and the existence of well-defined phases. Random variables produced by a random number generator are commonly used as input data.

The approach algorithm is demonstrated in five phases, each of which is interactive:

- **Phase 1:** Create a parametric model, y = f (x1, x2, ..., xq)
- **Phase 2:** Create a random input set of data, xi1, xi2, ..., xiq
- **Phase 3:** Calculate effectively and memorize results as yi
- **Phase 4:** Repeat steps 2 and 3 for i = 1 to n (n >= 5000)
- **Phase 5:** Analyze the findings using histograms, confidence intervals, and other statistical indicators generated by the simulation, among other things.

A parametric deterministic model creates a collection of input variables that are then reported to a set of output variables. The input variables are randomized (being represented by a random distribution) in the stochastic model of uncertainty propagation, and the outcome will be random as well, generally following the Normal Distribution. Monte Carlo simulation is based on this idea.

On a final note, under these assumptions, we know that the least squares estimators are the best linear unbiased estimators of the regression parameters. And if the random errors are normal, we may be certain that the estimators have normal distributions in repeated experiments. It's tough to comprehend the concept of "repeated trials." Random number generators are used in Monte Carlo simulation experiments to imitate the random nature of data collection. We define a data creation technique and produce samples of fake data in Monte Carlo simulations. Then we use the data we've collected to "test out" estimate approaches. We generate a large number of N-samples and investigate the estimators' repeated sampling characteristics. This allows us to investigate how statistical techniques operate in perfect and less-than-ideal situations. This is critical since economic, commercial, and social science facts aren't always (or even generally) as lovely as our assumptions.

For the simple linear regression model, the data creation procedure is as follows:

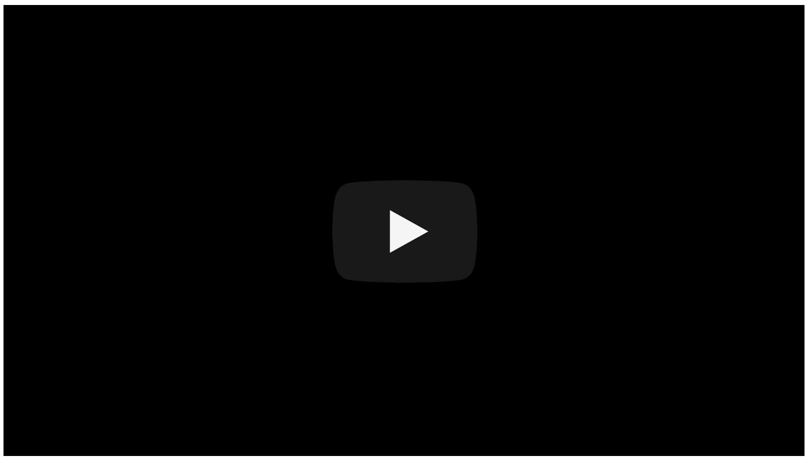
$$y_i = E(y_i|x_i) + e_i = \beta_1 + \beta_2 x_i + e_i, \quad i = 1, \ldots , N$$

By adding a random error ei to the regression function E, each value of the dependent variable yi is acquired, or produced (yi|xi). We construct values for the systematic component of the regression relationship E(yi|xi) and add the random error ei to mimic yi values. This is similar to a physical experiment in which the variables are fixed, and the experiment is conducted. Because of random uncontrolled mistakes, the outcome varies from trial to trial.

Monte Carlo Simulations

Objectives:

- Students will be able to summarize the video on the Monte Carlo Simulation (MIT OpenCourseWare).



The following content is from https://www.toptal.com/finance/financial-modeling/python-and-finance

It is a step-by-step tutorial with using Python and finance together, giving you insight on how Stefan Thelin, who chronicled this tutorial, creates a simplified version of the Monte Carlo simulation with Python.

Step-by-step Tutorial of Using Python and Finance Together

What follows is a step-by-step tutorial showing how to create a simplified version of the Monte Carlo simulation but using Python instead of the @RISK plugin for Excel.

Monte Carlo methods rely on random sampling to obtain numerical results. One such application is to draw random samples from a probability distribution representing uncertain potential future states of the world where variables or assumptions can take on a range of values.

It is helpful to do the Monte Carlo simulation on a simplified DCF valuation model instead of the more common examples you see showing valuation of options or other derivatives, since for this we don't need any math beyond the basics of calculating the financial statements and discounting cash flows, allowing us to focus on the Python concepts and tools. Please note though that this basic tutorial model is meant to illustrate the key concepts, and is not useful as-is for any practical purposes. I also won't touch on any of the more academic aspects of Monte Carlo simulations.

The tutorial assumes that you are familiar with the basic building blocks of programming, such as variables and functions. If not, it might be helpful to take 10 minutes to check the key concepts in for example this introduction.

The Starting Point and Desired Outcome

I start with the same very simplified DCF valuation model used in the Monte Carlo simulation tutorial. It has some key line items from the three financial statements, and three highlighted input cells, which in the Excel version have point estimates that we now want to replace with probability distributions to start exploring potential ranges of outcomes.

The intention of this tutorial is to give finance professionals new to Python an introduction not only to what a useful program might look like, but an introduction also to the iterative process you can use to develop it. It, therefore, has two parts:

1. First, I develop a working prototype using a straightforward approach which I think is easy to follow and not completely unlike the process one could use to start this project if you were to start from scratch.
2. Then, after having developed the working prototype, I walk through the process of refactoring - changing the structure of code without changing its functionality. You may want to stick around for that part - it

is a more elegant solution than the first one, and, as a bonus, it is about 75x faster in terms of execution time.

1. Developing a Working Prototype

Setting up the Jupyter Notebook

The Jupyter notebook is a great tool for working with Python interactively. It is an interactive Python interpreter with cells that can contain code, Markdown text, images, or other data. For this tutorial I used the Python Quant Platform, but I can also recommend Colaboratory by Google, which is free and runs in the cloud. Once there, simply select "New Python 3 Notebook" in the "File" menu, and you are ready to go.

Having done that, the next step is to import the third-party packages we need for data manipulation and visualizations, and tell the program that we want to see charts inline in our notebook, instead of in separate windows:

```
import numpy as np
import pandas as pd
import matplotlib.pyplot as plt
%matplotlib inline
```

A note before we start naming our first variables. As I already highlighted, readability is one of Python's strengths. Language design goes a long way to support that, but everyone writing code is responsible for making it readable and understandable, not only for others but also for themselves.
As Eagleson's Law states, "Any code of your own that you haven't looked at for six or more months might as well have been written by someone else."

A good rule of thumb is to name the components of your program in such a way that you minimize the need for separate comments that explain what your program does.

With that in mind, let's move on.

Creating the Financial Statements

There are many ways that we can work with existing spreadsheet data in Python. We could, for example, read a sheet into a Pandas DataFrame with one line of code using the `read_excel` command. If you want a tighter integration and real-time link between your spreadsheet and Python code, there are both free and commercial options available to provide that functionality.

Since the model here is very simple, and to focus us on the Python concepts, we will be recreating it from scratch in our script. At the end of the first part, I will show how you can export what we have created to a spreadsheet.

As a first step towards creating a Python representation of the financial statements, we will need a suitable data structure. There are many to choose from, some built into Python, others from various libraries, or we can create our own. For now, let's use a Series from the Pandas library to have a look at its functionality:

```
years = ['2018A', '2019B', '2020P', '2021P', '2022P', '2023P']
sales = pd.Series(index=years)
sales['2018A'] = 31.0  sales
```

This input and its corresponding output is shown below:

```
In [2]: years = ['2018A', '2019B', '2020P', '2021P', '2022P', '2023P']
        sales = pd.Series(index=years)
        sales['2018A'] = 31.0
        sales

Out[2]: 2018A    31.0
        2019B     NaN
        2020P     NaN
        2021P     NaN
        2022P     NaN
        2023P     NaN
        dtype: float64
```

With the first three lines we have created a data structure with an index consisting of years (each marked to show if it is Actual, Budget or Projected), a starting value (in millions of euros, as in the original DCF model), and empty (NaN, “Not a Number”) cells for the projections. The fourth line prints a representation of the data - in general, typing the name of a variable or other objects in the interactive interpreter will usually give you a sensible representation of it.

Next, we declare a variable to represent the projected annual sales growth. At this stage, it is a point estimate, the same figure as in our original DCF model. We want to first use those same inputs and confirm that our Python version performs the same and gives the same result as the Excel version, before looking at replacing point estimates with probability distributions. Using this variable, we create a loop that calculates the sales in each year of the projections based on the previous year and the growth rate:

```
growth_rate = 0.1
for year in range(1, 6):    sales[year] = sales[year − 1] * (1
+ growth_rate)    sales
```

We now have projected sales, instead of NaN:

```
In [3]: growth_rate = 0.1

        for year in range(1, 6):
            sales[year] = sales[year - 1] * (1 + growth_rate)

        sales

Out[3]: 2018A    31.00000
        2019B    34.10000
        2020P    37.51000
        2021P    41.26100
        2022P    45.38710
        2023P    49.92581
        dtype: float64
```

Using the same approach, we continue through the financial statements, declaring variables as we need them and performing the necessary calculations to eventually arrive at free cash flow. Once we get there we can check that what we have corresponds to what the Excel version of the DCF model says.

```
ebitda_margin = 0.14
depr_percent = 0.032
ebitda = sales * ebitda_margin
depreciation = sales * depr_percent
ebit = ebitda - depreciation
nwc_percent = 0.24
nwc = sales * nwc_percent
change_in_nwc = nwc.shift(1) - nwc
capex_percent = depr_percent
capex = -(sales * capex_percent)
tax_rate = 0.25
tax_payment = -ebit * tax_rate
tax_payment = tax_payment.apply(lambda x: min(x, 0))
free_cash_flow = ebit + depreciation + tax_payment + capex +
change_in_nwc
free_cash_flow
```

This gives us the free cash flows:

```
In [4]: ebitda_margin = 0.14
        depr_percent = 0.032

        ebitda = sales * ebitda_margin
        depreciation = sales * depr_percent
        ebit = ebitda - depreciation
```

```
In [5]: nwc_percent = 0.24

        nwc = sales * nwc_percent
        change_in_nwc = nwc.shift(1) - nwc
        capex_percent = depr_percent
        capex = -(sales * capex_percent)

        tax_rate = 0.25

        tax_payment = -ebit * tax_rate
        tax_payment = tax_payment.apply(lambda x: min(x, 0))
        free_cash_flow = ebit + depreciation + tax_payment + capex + change_in_nwc

        free_cash_flow
```

```
Out[5]: 2018A         NaN
        2019B    2.018100
        2020P    2.219910
        2021P    2.441901
        2022P    2.686091
        2023P    2.954700
        dtype: float64
```

The one line above that perhaps needs a comment at this stage is the second `tax_payment` reference. Here, we apply a small function to ensure that in scenarios where profit before tax becomes negative, we won't then have a positive tax payment. This shows how effectively you can apply custom functions to all cells in a Pandas Series or DataFrame. The actual function applied is, of course, a simplification. A more realistic model for a larger valuation exercise would have a separate tax model that calculates actual cash taxes paid based on a number of company-specific factors.

Performing the DCF Valuation

Having arrived at projected cash flows, we can now calculate a simple terminal value and discount all cash flows back to the present to get the DCF result. The following code introduces indexing and slicing, which allows us to access one or more elements in a data structure, such as the Pandas Series object.

We access elements by writing square brackets directly after the name of the structure. Simple indexing accesses elements by their position, starting with zero, meaning that `free_cash_flow[1]` would give us the second element. `[-1]` is shorthand for accessing the last element (the last year's cash flow is used to calculate the terminal value), and using a colon gives us a slice, meaning that `[1:]` gives us all elements except the first one, since we don't want to include the historical year `2018A` in our DCF valuation.

```
cost_of_capital = 0.12
terminal_growth = 0.02
terminal_value = ((free_cash_flow[-1] * (1 + terminal_growth))
/
                 (cost_of_capital - terminal_growth))
discount_factors = [(1 / (1 + cost_of_capital)) ** i for i in
range (1,6)]
dcf_value = (sum(free_cash_flow[1:] * discount_factors) +
            terminal_value * discount_factors[-1])
dcf_value
```

```
In [6]: cost_of_capital = 0.12
        terminal_growth = 0.02

        terminal_value = ((free_cash_flow[-1] * (1 + terminal_growth)) /
                          (cost_of_capital - terminal_growth))

        discount_factors = [(1 / (1 + cost_of_capital)) ** i for i in range (1,6)]

        dcf_value = (sum(free_cash_flow[1:] * discount_factors) +
                    terminal_value * discount_factors[-1])

        dcf_value
Out[6]: 25.794384011137922
```

That concludes the first part of our prototype - we now have a working DCF model, albeit a very rudimentary one, in Python.

Exporting the Data

Before moving on to the actual Monte Carlo simulation, this might be a good time to mention the exporting capabilities available in the Pandas package. If you have a Pandas DataFrame object, you can write that to an Excel file with one line using the `to_excel` method. There is similar functionality to export to more than a dozen other formats and destinations as well.

```
output = pd.DataFrame([sales, ebit, free_cash_flow],
                      index=['Sales', 'EBIT', 'Free Cash
Flow']).round(1)
output.to_excel('Python DCF Model Output.xlsx')
output
```

```
In [7]: output = pd.DataFrame([sales, ebit, free_cash_flow],
                              index=['Sales', 'EBIT', 'Free Cash Flow']).round(1)

        output.to_excel('Python DCF Model Output.xlsx')

        output
```

Out[7]:

	2018A	2019B	2020P	2021P	2022P	2023P
Sales	31.0	34.1	37.5	41.3	45.4	49.9
EBIT	3.3	3.7	4.1	4.5	4.9	5.4
Free Cash Flow	NaN	2.0	2.2	2.4	2.7	3.0

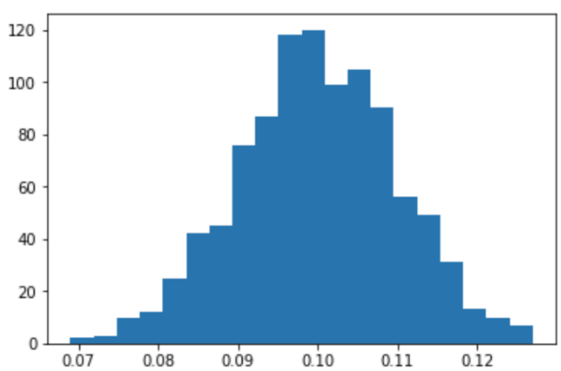
Creating Probability Distributions for Our Monte Carlo Simulation

Now we are ready to tackle the next challenge: to replace some of the point estimate inputs with probability distributions. While the steps up to this point may have seemed somewhat cumbersome compared to building the same model in Excel, these next few lines will give you a glimpse of how powerful Python can be.

Our first step is to decide how many iterations we want to run in the simulation. Using 1,000 as a starting point strikes a balance between getting enough data points to get sensible output plots, versus having the simulation finish within a sensible time frame. Next, we generate the actual distributions. For the sake of simplicity, I generated three normal distributions here, but the NumPy library has a large number of distributions to choose from, and there are other places to look as well, including the Python standard library. After deciding which distribution to use, we need to specify the parameters required to describe their shape, such as mean and standard deviation, and the number of desired outcomes.

```
iterations = 1000
sales_growth_dist = np.random.normal(loc=0.1, scale=0.01,
size=iterations)
ebitda_margin_dist = np.random.normal(loc=0.14, scale=0.02,
size=iterations)
nwc_percent_dist = np.random.normal(loc=0.24, scale=0.01,
size=iterations)
plt.hist(sales_growth_dist, bins=20)
plt.show()
```

```
In [8]: iterations = 1000
        sales_growth_dist = np.random.normal(loc=0.1, scale=0.01, size=iterations)
        ebitda_margin_dist = np.random.normal(loc=0.14, scale=0.02, size=iterations)
        nwc_percent_dist = np.random.normal(loc=0.24, scale=0.01, size=iterations)

        plt.hist(sales_growth_dist, bins=20)
        plt.show()
```



Here you could argue that EBITDA should not be a separate random variable independent from sales but instead correlated with sales to some degree. I would agree with this, and add that it should be driven by a solid understanding of the dynamics of the cost structure (variable, semi-variable and fixed costs) and the key cost drivers (some of which may have their own probability distributions, such as for example input commodities prices), but I leave those complexities aside here for the sake of space and clarity.

The less data you have to inform your choice of distribution and parameters, the more you will have to rely on the outcome of your various due diligence workstreams, combined with experience, to form a consensus view on ranges of likely scenarios. In this example, with cash flow projections, there will be a large subjective component, which means that visualizing the probability distributions becomes important. Here, we can get a basic visualization, showing the sales growth distribution, with only two short lines of code. This way we can quickly view any distribution to eyeball one that best reflects the team's collective view.

Now we have all the building blocks we need to run the simulation, but they are not in a convenient format for running the simulation. Here is the same code we have worked with thus far but all gathered in one cell and rearranged into a function for convenience:

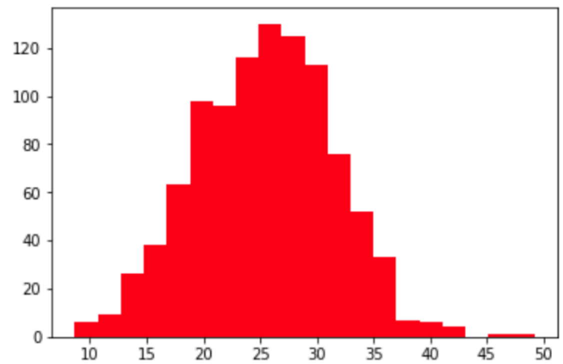
```
def run_mcs():

    # Create probability distributions
    sales_growth_dist = np.random.normal(loc=0.1, scale=0.01,
size=iterations)
    ebitda_margin_dist = np.random.normal(loc=0.14, scale=0.02,
size=iterations)
    nwc_percent_dist = np.random.normal(loc=0.24, scale=0.01,
size=iterations)

    # Calculate DCF value for each set of random inputs
    output_distribution = []
    for i in range(iterations):
        for year in range(1, 6):
            sales[year] = sales[year - 1] * (1 +
sales_growth_dist[0])
        ebitda = sales * ebitda_margin_dist[i]
        depreciation = (sales * depr_percent)
        ebit = ebitda - depreciation
        nwc = sales * nwc_percent_dist[i]
```

```
        change_in_nwc = nwc.shift(1) - nwc
        capex = -(sales * capex_percent)
        tax_payment = -ebit * tax_rate
        tax_payment = tax_payment.apply(lambda x: min(x, 0))
        free_cash_flow = ebit + depreciation + tax_payment +
capex + change_in_nwc

        # DCF valuation
        terminal_value = (free_cash_flow[-1] * 1.02) /
(cost_of_capital - 0.02)
        free_cash_flow[-1] += terminal_value
        discount_factors = [(1 / (1 + cost_of_capital)) ** i
for i in range (1,6)]
        dcf_value = sum(free_cash_flow[1:] * discount_factors )
        output_distribution.append(dcf_value)

    return output_distribution
```

We can now run the whole simulation and plot the output distribution, which will be the discounted cash flow value of this company in each of the 1,000 iterations, with the following code. The command is not Python code but a notebook shorthand that measures the time to run something (you could instead use the Python function from the standard library). It depends on the computer you run it on, but this version needs 1-2 seconds to run the 1,000 iterations and visualize the outcome.

In [10]:
```
%time plt.hist(run_mcs(), bins=20, color='r')
plt.show()
```

```
CPU times: user 1.38 s, sys: 4 ms, total: 1.38 s
Wall time: 1.35 s
```



For more information on [EBITDA]

2. Refining the Prototype

Refactoring refers to the process of rewriting existing code to improve its structure without changing its functionality, and it can be one of the most fun and rewarding elements of coding. There can be several reasons to do this. It might be to:

1. Organize the different parts in a more sensible way.
2. Rename variables and functions to make their purpose and workings clearer.
3. Allow and prepare for future features.
4. Improve the execution speed, memory footprint or other resource utilization.

To show what one step in that process might look like, I cleaned up the prototype that we just walked through by collecting all initial variables in one place, rather than scattered throughout as in the prototype script, and optimized its execution speed through a process called *vectorization*.

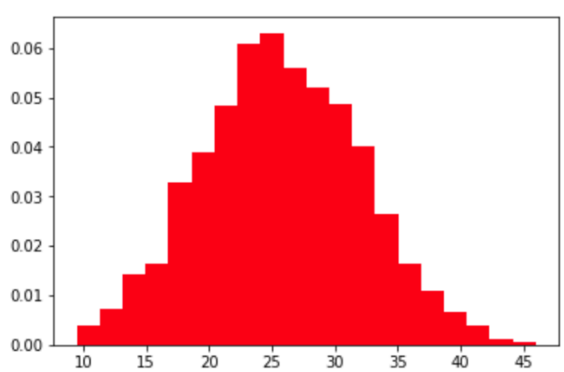
It now looks cleaner and easier to understand:

```
# Key inputs from DCF model
years = 5
starting_sales = 31.0
capex_percent = depr_percent = 0.032
sales_growth = 0.1
ebitda_margin = 0.14
nwc_percent = 0.24
tax_rate = 0.25
# DCF assumptions
r = 0.12
g = 0.02
# For MCS model
iterations = 1000
sales_std_dev = 0.01
ebitda_std_dev = 0.02
nwc_std_dev = 0.01


def run_mcs():

    # Generate probability distributions
    sales_growth_dist = np.random.normal(loc=sales_growth,
                                         scale=sales_std_dev,
                                         size=(years,
iterations))
    ebitda_margin_dist = np.random.normal(loc=ebitda_margin,
                                          scale=ebitda_std_dev,
                                          size=(years,
iterations))
    nwc_percent_dist = np.random.normal(loc=nwc_percent,
                                        scale=nwc_std_dev,
                                        size=(years,
iterations))

    # Calculate free cash flow
    sales_growth_dist += 1
    for i in range(1, len(sales_growth_dist)):
        sales_growth_dist[i] *= sales_growth_dist[i-1]
```

```
    sales = sales_growth_dist * starting_sales
    ebitda = sales * ebitda_margin_dist
    ebit = ebitda - (sales * depr_percent)
    tax = -(ebit * tax_rate)
    np.clip(tax, a_min=None, a_max=0)
    nwc = nwc_percent_dist * sales
    starting_nwc = starting_sales * nwc_percent
    prev_year_nwc = np.roll(nwc, 1, axis=0)
    prev_year_nwc[0] = starting_nwc
    delta_nwc = prev_year_nwc - nwc
    capex = -(sales * capex_percent)
    free_cash_flow = ebitda + tax + delta_nwc + capex
    # Discount cash flows to get DCF value
    terminal_value = free_cash_flow[-1] * (1 + g) / (r - g)
    discount_rates = [(1 / (1 + r)) ** i for i in range (1,6)]
    dcf_value = sum((free_cash_flow.T * discount_rates).T)
    dcf_value += terminal_value * discount_rates[-1]

    return dcf_value
```

The main difference you will notice between this version and the previous one is the absence of the `for i in range(iterations)` loop. Using NumPy's array operation, this version runs in 18 milliseconds compared to the 1.35 seconds for the prototype version - roughly 75x faster.

```
In [4]: %time plt.hist(run_mcs(), bins=20, density=True, color="r")
        plt.show()

        CPU times: user 20 ms, sys: 0 ns, total: 20 ms
        Wall time: 18 ms
```



I’m sure that further optimization is possible, since I put together both the prototype and refined version in a short time solely for the purpose of this tutorial.

Taking it Further

This tutorial showed some of the powerful features of Python, and if you were to develop this further the opportunities are almost endless. You could for example:

- Scrape or download relevant company or sector statistics from web pages or other data sources, to help inform your choice of assumptions and probability distributions.
- Use Python in quantitative finance applications, such as in an automated trading algorithm based on fundamental and/or macroeconomic factors.
- Build exporting capabilities that generate output in a spreadsheet and/or presentation format, to be used as part of your internal transaction review and approval process, or for external presentations.

I haven’t even touched upon what you could also do with the various web, data science, and machine learning applications that have contributed to Python’s success.

In Summary: A Useful Language for Your Financial Toolbox

This article gave an introduction to the Python programming language, listed some of the reasons why it has become so popular in finance and showed how to build a small Python script. In a step-by-step tutorial, I walked through how Python can be used for iterative prototyping, interactive financial analysis, and for application code for valuation models, algorithmic trading programs and more.

For me, at the end of the day, the killer feature of Python technology is that it is simply fun to work with! If you enjoy problem-solving, building things and making workflows more efficient, then I encourage you to try it out. I would love to hear what you have done with it or would like to do with it.

Introduction to Statistical Use Cases in FinTech

Objectives:

- Students will complete an extensive review of current and potential statistical use cases in FinTech.

Cutting-edge innovations like blockchain and artificial intelligence are ushering in new ways of doing business. Fields including electronic payments, banking, insurance, personal loans, and wealth management are all getting a digital facelift. Statistics show that the tide is turning as established companies realize the potential and necessity of these new technologies.In recent years, the financial industry has experienced disruptions by Fintech which are related to providing consumers with alternatives to traditional options.

Consumers expect to have a seamless digital experience when handling their money and investments. To stay afloat, financial companies must provide such services to their consumers. More and more now, there are partnerships being established between traditional companies and Fintech startups to provide a business-to-business approach. This is to offer its technology to larger companies and more consumers.

FinTech companies depend, heavily, on machine learning, artificial intelligence (AI), predictive analysis and data science to make financial decisions simplified while providing optimal solutions. Data science is used in FinTech through the following examples:

- **Robo-Advisors** - process starts with collecting information about the client through an online survey where the client's profile is captured, such as their financial status, risk capacity, future financial goals, etc and then the data is used to processed to provide financial advice or automatically invest client assets in instruments and asset classes best suited for their needs and goals.
- **Risk Analysis** - use logistic regression to predict the risk of customers and separate good borrowers from bad ones.
- **Fraud Detection** - leverage big data and data analytics techniques where vast amounts of online fraudulent transactions can be used and modeled in a way that can help us flag or predict fraud in future transactions.
- **Customer Acquisition and Retention** - an algorithm could be built to predict what additional products or services the customer would like to purchase based on their historical purchase behavior.
- **Insurance Products** - claims department in an insurance company uses data science algorithms to separate fraudulent from non-fraudulent transactions.

Scientific Libraries & NumPy

Objectives:

- Students will review the benefits of libraries for FinTech programming
- Students will review the role of NumPy FinTech programming

A large amount of data science and machine learning is built on a few specific branches of mathematics. Specifically, Linear Algebra and Statistics. Linear Algebra deals with computation involving matrices. The Python libraries used to conduct efficient matrix calculations are called Numpy and Scipy.

NumPy

NumPy is a library for Python that supports large multidimensional arrays and matrices. Later on, we will manipulate datasets using the Pandas library which is built around NumPy. NumPy has a lot of utility and is able to perform complex mathematical operations quickly and efficiently. In Machine Learning using Python, these arrays will be the data structure used for handing off our transformed data to our Machine Learning algorithm with the help of Scikit-Learn.

Learning the basics of NumPy will help you become a data manipulation master and is a fast way to perform large amounts of matrix operations locally.

Additional Resources:

- Documentation
- NumPy Reference PDF
- Wikipedia
- Chapter 2: Introduction to NumPy

Quiz Review

Correct answers are in bold.

NumPy is a Python Library that supports large multidimensional arrays and matrices.

- **A. True**
- B. False

NumPy is not efficient for manipulating data.

- A. True
- **B. False**

Intro: Financial Modeling using Python

Objectives:

- Students will be able to provide explanations on how Python is used for Financial Modeling.
- Students will be able to apply Python in a Financial Modeling scenario.

Financial modeling using Python is a method of building a model using the Python programming language. The language allows coders to modify and analyze Excel spreadsheets and automate certain tasks. As an example, the task of copying data from one spreadsheet to another can be automated with code, and searching for errors can be dramatically sped up.

Python is one of the popular programming languages used in finance. Guido van Rossum created Python, which was released for the first time in 1991. Currently, it is one of the programming languages used in financial modeling .

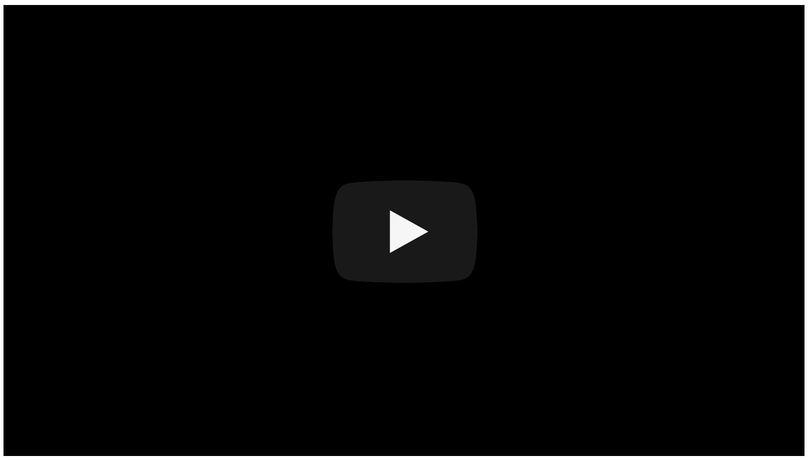
Companies used to stay within their industry, but they eventually turn their attention to tech firms and take advantage of innovations and tools that make handling financial transactions much easier, especially in managing large volumes of data.

Morgan Stanley, the Investment Banking Company, quoted on their website

> *Over the long term, tech advances such as artificial intelligence (AI) and blockchain will clearly play a role in the evolution of banking……. In order to remain competitive, banks will need to update technology on the back end in order to deliver a seamless experience on the front end since customers will have little tolerance for glitchy apps no matter how sleek*

> *the user interface.*

and to stress the “evolution of banking”, investment banks and financial institutions will need very talented researchers and engineers in the fields of computer science and data science with the support of the finest of technologies. They will not only collect, clean and organize data but will also create applications based on mathematical models, maintain servers that process collected data, and tweak those models continuously.



Financial Modeling using Python

Objectives:

- Students will be able to explain how Python is used for financial modeling.
- Students will be able to describe the process of using Python for Excel integration.

Python

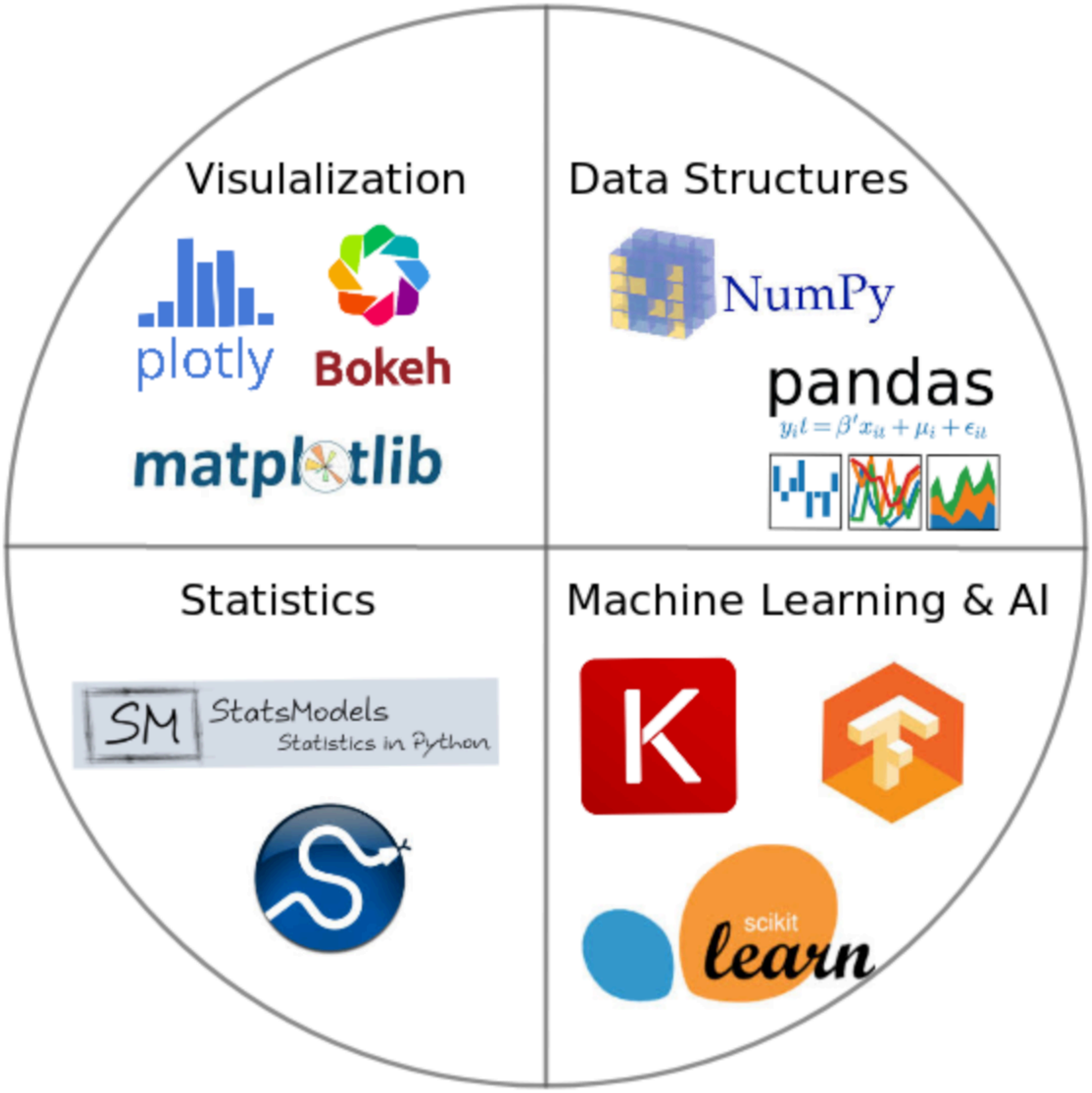
According to Investopedia,

> *Fintech, a portmanteau of ‘financial technology,’ is used describe new tech that seeks to improve and automate the delivery and use of financial services. At its core, fintech is utilized to help companies, business owners and consumers better manage their financial operations, processes and lives by utilizing specialized software and algorithms that are used on computers and, increasingly, smartphones.*

From the data published in “The Pulse of Fintech in 2018” by KPMG

Python as an ecosystem

Easier implementation coupled with vast ocean of libraries for mathematical computations, data collection, machine learning, visualization of data and even development of applications based on those models have transformed Python into a complete ecosystem for data science projects.



Python's ecosystem for data science

What is Financial Modeling in Python?

> *Financial Modeling in Python refers to the method that is used to build a financial model using high-level python programming language that has a rich collection of built-in data types. This language can be used for modification and analysis of excel spreadsheets as well as automation of certain tasks that exhibit repetition. Given that financial models use spreadsheets extensively, Python has become one of the most popular programming languages in the field of finance.*

Extending Python

There are certain limitations in Python that can be overcome with the extension modules using C. These extension modules can be used to add new built-in object types to Python and can call functions from the C library. A certain set of functions, macros, and variables available in Python API to support such extensions. The header '*Python.h*' is included in a C source file for Python API.

Python Excel Integration

Some of the Python Excel integration tools that can be used to supercharge the existing excel functionality are as follows:

- **xlwings:** This package can be used to move the backend processing from VBA to Python. After that, the users can continue using Excel seamlessly while using each control button to call Python scripts.
- **Jupyter Notebook:** It allows users to leverage Python for creating interactive, shareable, and web-based documents that can contain visualizations, code, and text.
- **Pandas Library:** It can be used to quickly load data from excel spreadsheets into SQL database or pandas DataFrames. In either case, data can be analyzed and explored swiftly.

Python Data Model

Objects are the underlying essence of a Python data model. All the data in a Python program is either represented by objects straightaway or by the relationship between objects. An object can be recognized by its identity, type, and value.

1. **Identity:** It refers to the address of an object in the memory, and it never changes once created.
2. **Type:** It defines the operations that an object supports along with the possible value for that object type.

3. **Value:** The value of an object may change. The ones that change are known as mutable, while the unchangeable ones are known as immutable.

Misconceptions about Python

- It is a pure scripting language as it uses simple syntax and cross-platform support.
- It doesn't have a compiler like other languages.
- It lacks scalability, and as such, it can't support any significantly large user base.
- It is perceived to be very slow.
- It doesn't support concurrency.

Significance of Financial Modeling in Python

Python has grown to become one of the most popular programming languages used for financial modeling. Companies nowadays seek innovative tools for handling large volumes of financial data in a much easier way and Python fits into that criteria perfectly.

Practical Business Python

[Taking care of business, one python script at a time]

Financial Modeling Techniques

Objectives:

- Students will be able to explain the four financial modeling techniques discussed in this lesson.
- Students will be able to go in detail regarding assumptions in financial modeling.

Techniques

A financial model represents the financial performance of a company for both the past and future. Models being very cohesive it's also advisable to build a financial model in excel. Knowledge of Excel, knowledge of accounting and knowledge of financial modeling techniques, corporate finance, understanding the company's operations are some of the financial modeling skill sets required in an individual in order to build a model.

Financial Modeling Techniques

Mr. Raj, a research analyst prepared a financial model on company ABC and unfortunately got sick and went on leave. During his absence, the market moved exactly opposite to his expectations and the financial model of company ABC required the changes as per the current situation. Due to Mr. Raj Absence, his assistant Mr. Saurabh is asked to incorporate the necessary changes in the financial model of company ABC.Mr. Raj knew how to prepare a financial model but he lacked knowledge of important financial modeling techniques.

Mr. Saurabh opens the model and gets confused looking at the model as he is not able to find out which one is the right cell in which changes need to be incorporated. In some cells, due to interlinkages, there is no value that can be seen.

What do you think why did Mr. Saurabh faced a lot of problems with the financial model. Do you think a model which another person is unable to understand is a good model?? According to me the answer to this question is No.

A good financial model should always be:-

- Realistically based on reasonable and defensible assumptions and projections
- Flexible and adaptable to dynamic working schedules (or modules)
- Easy to follow, should not intimidate the reader

Wondering how can a model have these features. So let’s learn some important financial modeling techniques and make a model flexible and easy to understand.

Financial Modeling Techniques are as follows:

1. Financial modeling techniques – Historical data

Your assumption for the future years is based on your historical. So it is very important to gather the right data from the right source. While gathering data remember one thing you are an analyst, not an auditor. So if the annual reports published by the company do not tally don’t panic and sit to tally them.

2. Financial modeling techniques – Assumption

Financial models need to have clear and well-defined assumptions which are Referred to as ‘drivers’ or ‘inputs’ these are based on a thorough understanding of the business

Assumptions should reflect business realities and expectations

In order to come up with an assumption analyzing the historical plays a vital role. To analyze the historicals one should do a ratio analysis of the company financials and come up with answers to a certain question like

- Whether a certain ratio has declined or is growing
- What are the reasons behind this declining or growing percentage
- How would it affect future

The other criteria which one should consider while making an assumption are

- No bias should get into the assumptions on the business
- Clearly, understanding the expected changes in future performance
- Understand Management expectations
- Check out what other analysts think about the company

3. Financial modeling techniques – Color coding /Linkages

Formatting is very important in anything you prepare. In financial modeling, color coding is one of the formattings which one needs to take care of.

Let’s consider an example and try to understand why color coding is so important.

You have prepared a financial model but the color of all the numbers are the same and you are on leave. There is some very important news that has been published which would change the assumptions that you had made for that particular company and your colleague wants to come up with the target price. In order to come up with a target price, your colleague has to change certain things in the model. Since it has the same color throughout your colleague is finding very difficult to find the right cell in which changes need to do.

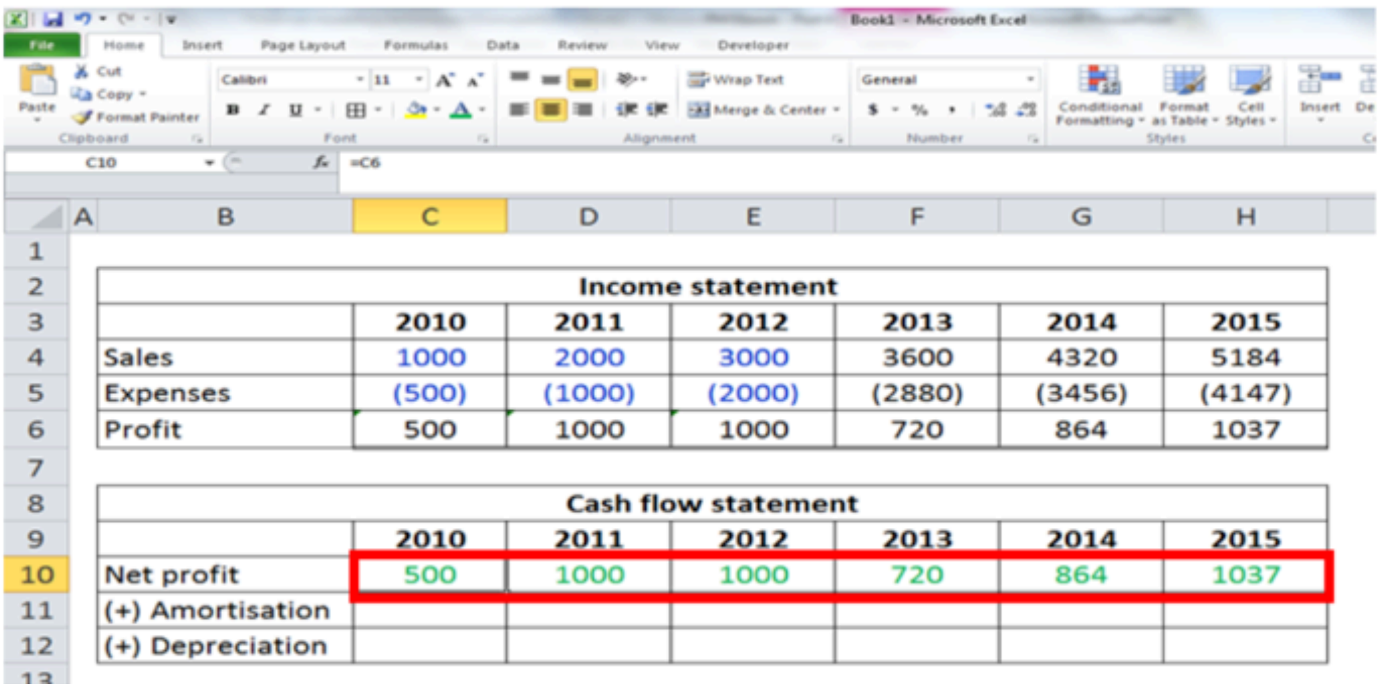
What can be done to overcome this situation?

A right color coding would solve this problem. So there should always be different color coding for Historical inputs, formulas, and linkages. This would help your colleague to understand the financial model and make the necessary changes in the right cell.

We have used certain color coding

Historical inputs in Blue

Formulas in Black Linkages in green



Income statement						
	2010	2011	2012	2013	2014	2015
Sales	1000	2000	3000	3600	4320	5184
Expenses	(500)	(1000)	(2000)	(2880)	(3456)	(4147)
Profit	500	1000	1000	720	864	1037

Cash flow statement						
	2010	2011	2012	2013	2014	2015
Net profit	500	1000	1000	720	864	1037
(+) Amortisation						
(+) Depreciation						

4. Financial Modeling Techniques – a Circular reference

A circular reference is a series of references where the last object references the first, resulting in a closed-loop.

Below is an example:

You need to calculate the net income from the income statement. While calculating the net income, interest income is one of the items that need to be calculated. You are calculating net income as a percentage on the ending cash and cash balances which get calculated in the cash flow statement.

Over here you are assuming that the entire cash balance we have deposited in a bank.

Income Sheet (Rs m)	**Year 1**
Net Sales	
(-)Direct Costs	
Gross Profit	
(-)Selling, General & Admin Costs	
EBITDA	
(-)Depreciation/Amortisation	
EBIT	
(-)Interest Expense	
(+)Interest Income	
Pretax Income	
(-)Income Taxes	
Net Income	

Here to calculate the right net income you need to calculate interest income. Interest income will not be calculated unless you prepare a cash flow statement. So, see what is required to prepare the cash flow statement.

Cash Flow Statement	Year 1
Operating Activities	
Net Income	
Depreciation/Amortization	
Change in Working Capital	
Cash Flow from Operating Activities	
Investment Activities	
Capital Expenditures	
Additions to Intangibles	
Cash Flow from Investing Activities	
Financing Activities	
Issuance/ (Repayment) of Long-Term Debt	
Issuance/ (Repurchase of) Equity	
Cash Flow from Financing Activities	
Net Change in Cash	
Beginning Cash Balance	
Ending Cash Balance	

You can see here we need net income to calculate the ending cash balance which will be used in calculating interest income.

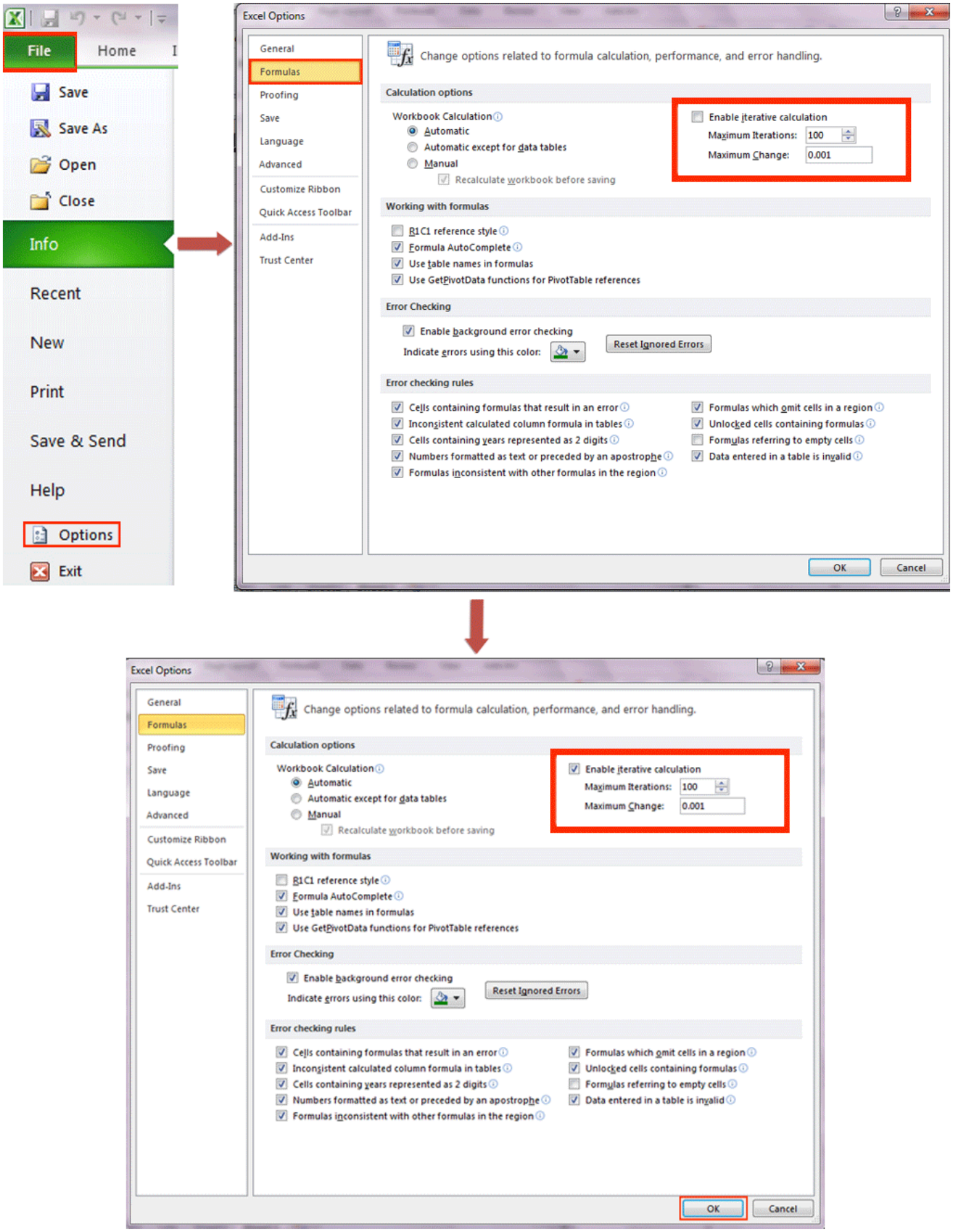
Cash balances	Year 1
Average Cash Balance	
Interest Rate	
Interest Income	

To do all this:

First, you will calculate net income by considering interest income to be 0. This net income will get linked to the cash flow statement through which you will be able to find the ending cash balance. Then this ending cash balance will get linked to average cash balances which will help calculate the interest income. Later, you will link this interest income to the income statement and find out the right net income balance. So, you must be wondering whether the new net income figure will get reflected in the cash flow statement.. Yes, through circular reference, this entire process will be done automatically and accordingly the other figures in the income statement, balance sheet and cash flow statement would also be changed. But remember one thing excel cannot calculate automatically when the model contains a circular reference. You need to Turn ON “Iterations” in order to resolve the situation.

Go to

File >>>Options >>>> Formulas >>>>> Enable iterative calculation >>>> OK



File
Home
Save
Save As
Open
Close
Info
Recent
New
Print
Save & Send
Help
Options
Exit
Excel Options
General
Formulas
Proofing
Save
Language
Advanced
Customize Ribbon
Quick Access Toolbar
Add-Ins
Trust Center
Change options related to formula calculation, performance, and error handling.
Calculation options
Workbook Calculation
Automatic
Automatic except for data tables
Manual
Recalculate workbook before saving
Enable iterative calculation
Maximum Iterations: 100
Maximum Change: 0.001
Working with formulas
R1C1 reference style
Formula AutoComplete
Use table names in formulas
Use GetPivotData functions for PivotTable references
Error Checking
Enable background error checking
Indicate errors using this color:
Reset Ignored Errors
Error checking rules
Cells containing formulas that result in an error
Inconsistent calculated column formula in tables
Cells containing years represented as 2 digits
Numbers formatted as text or preceded by an apostrophe
Formulas inconsistent with other formulas in the region
Formulas which omit cells in a region
Unlocked cells containing formulas
Formulas referring to empty cells
Data entered in a table is invalid
OK
Cancel

Trading Strategies & Asset Types

Objectives:

- Students will be able to identify the considerations involved in Trend Following.
- Students will be able to explain how statistical arbitrage relates to mean reversion in trading.
- Students will become familiar with the Quant Crash of 2007.
- Students will become familiar with the different types of assets discussed in this lesson.
- Students will be able to describe the different types of alternative investments.

Trading Strategies

Trend Following

Trend following is an investment or trading strategy which tries to take advantage of long, medium or short-term moves that seem to play out in various markets. Traders who employ a trend following strategy do not aim to forecast or predict specific price levels; they simply jump on the trend (when they perceived that a trend has established with their own particular reasons or rules) and ride it. These traders normally enter in the market after the trend "properly" establishes itself, betting that the trend will persist for a long time, and for this reason they forego the initial turning point profit. A market "trend" is a tendency of a financial market price to move in a particular direction over time. If there is a turn contrary to the trend, they exit and wait until the turn establishes itself as a trend in the opposite direction. In case their rules signal an exit, the traders exit but re-enter when the trend re-establishes. Cutting Loss. Exit market when market turn against them to minimize losses, and "let the profits run", when the market trend goes as expected until the market exhausted and reverses to book profit. This trading or "betting with positive edge" method involves a risk management component that uses three elements: number of shares or futures held, the current market price, and current market volatility. An initial risk rule determines position size at time of entry. Exactly how much to buy or sell is based on the size of the trading account and the volatility of the issue. Changes in price may lead to a gradual reduction or an increase of the initial trade. On the other hand, adverse price movements may lead to an exit from the entire trade.

The key reasons for trending markets are a number of behavioral biases that cause market participants to over-react: Herding: After markets have trended, some traders jump on the bandwagon, and thus prolonging the herding effect and trends. Confirmation Bias: People tend to look for information that confirm their views and beliefs. This can lead investors to buy assets that have recently made money, and sell assets that have declined, causing trends to continue. Risk Management: Some risk-management models will sell in down markets as, for example, some risk budgets have been breached, and buy in up markets as new risk budgets have been unlocked, causing trends to persist. "Don't fight the tape" is a term that means do not bet or trade against the trend in the financial markets, i.e., if the broad market is moving up, do not bet on a downward move. The term "tape" refers to the ticker tape used to transmit the price of stocks. It is analogous to the trader's maxim, "The trend is your friend."

Considerations

- **Price:** One of the first rules of trend following is that the price is the main concern. Traders may use other indicators showing where the price may go next or what it should be but, as a general rule, these should be disregarded. A trader needs only to be worried what the market is doing, no what it might do. The current price and only the price tells what the market is doing.

- **Money Management:** Instead of the timing of the trade or the indicator, the decision of how much to trade over the course of the trend.
- **Risk Control:** Cut losses is the rule. Meaning that during periods of market volatility, the trading size is reduced. During losing periods, positions are reduced and trade size is cut back. The main objective is to preserve capital until more positive price trends reappear.
    - **Rules:** Trend following should be systematic. Price and time are pivotal at times. This technique is not based on an analysis of fundamental supply and demand factors.
- **Diversification:** Research published by hedge fund manager, Andrew Clenow, shows that cross asset diversification is an essential part of professional trend following.

Mean Reversion

Mean reversion is the assumption that an asset's price will tend to converge to the average price over time. This is a timing strategy involving both the identification of the trading range for a security and the computation of the average price using quantitative methods. It is a phenomenon that can be exhibited in a host of financial time-series data, from price data, earnings data, and book value.

When the current market price is less than the average past price, the security is considered attractive for purchase, with the expectation that the price will rise. When the current market price is above the average past price, the market price is expected to fall. In simpler terms, deviations from the average price are expected to revert to the average.

Stock reporting services commonly offer moving averages for periods such as 50 and 100 days. While reporting services provide the averages, identifying the high and low prices for the study period is still necessary.

Mean reversion has the appearance of a more scientific method of choosing stock buy and sell points than charting, because precise numerical values are derived from historical data to identify the buy/sell values, rather than trying to interpret price movements using charts (charting, also known as technical analysis) although the RSI indicator and Average True Range (ATR) are nascent attempts to capture such systematic pattern.

Many asset classes, even exchange rates, are observed to be mean reverting; however, this process may last for years and thus is not of value to a short-term investor.

Mean reversion should demonstrate a form of symmetry since a stock may be above its historical average approximately as often as below.

Statistical Arbitrage (*Stat Arb or StatArb*)

A class of short-term financial trading strategies that employ mean reversion models involving broadly diversified portfolios of securities (hundreds to thousands) held for short periods of time (generally seconds to days). These strategies are supported by substantial mathematical, computational, and trading platforms.

StatArb is a strategy that is bottom-up, beta-neutral in approach and uses statistical/econometric techniques to provide signals for execution. Signals are generated through a contrarian mean reversion principle but can also be designed using factors such as lead/lag effects and corporate activity.

StatArb evolved out of the simpler pairs trade, in which stocks are put into pairs by fundamental or market-based similarities. When one stock in a pair outperforms the other, the under performing stock is bought long and the outperforming stock is sold short. Many bank proprietary operations now center to varying degrees around statistical arbitrage trading.

StatArb is an attempt to find stocks with high correlation, cointegration, or other common factor characteristics. Portfolio construction is automated and consists of two phases. Each stock in the market is assigned a numeric score or rank that reflects its desirability. High scores indicate stocks that should be held long and low scores candidates for shorting.

Statistical arbitrage is also subject to model weakness as well as stock- or security-specific risk. Factors which the model may not be aware of having exposure to could become significant drivers of price action. Risk of M&A activity or even default for an individual name.

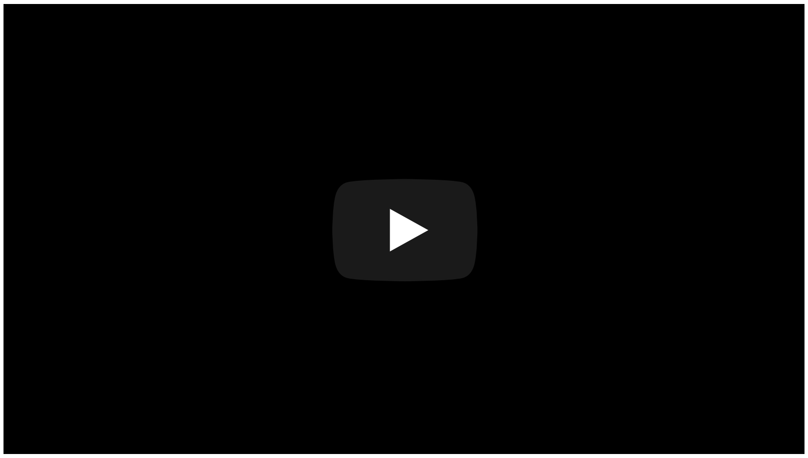
Quant Crash of 2007

During the summer of 2007, a number of StatArb (and other Quant type) hedge funds experienced significant losses at the same time. There have been no exact reasons of why this occurred, several published accounts blame the emergency liquidation of a fund that experienced capital withdrawals or margin calls. By closing out its positions quickly, the fund put pressure on the prices of the stocks. Because other StatArb funds had similar positions, due to the similarity of their alpha models and risk-reduction models, the other funds experienced adverse returns. One of the versions of the events describes how Morgan Stanley's highly successful StatArb fund, PDT, decided to reduce its positions in response to stresses in other parts of the firm, and how this contributed to several days of hectic trading.

StatArb has developed to a point where it is a significant factor in the marketplace, that existing funds have similar positions and are in effect competing for the same returns. Simulations of simple StatArb strategies by Khandani and Lo show that the returns to such strategies have been reduced considerably from 1998 to 2007. These events during August 2007 were linked to reduction of liquidity, possibly due to risk reduction by high-frequency market makers.

Machine Learning and Data Science

For further reading regarding Data Science and Machine Learning in trading check out Performance analysis of predictive (alpha) stock factors and Advances in Financial Machine Learning



Designated Market Maker

A designated market maker (DMM) is a market maker responsible for maintaining fair and orderly markets for an assigned set of listed stocks. Formerly known as specialists, the designated market maker is the official market maker for a set of tickers and, in order to maintain liquidity in these assigned stocks, will take the other side of trades when buying and selling imbalances occur. The DMM also serves as a point of contact on the trading floor for the listed company, and provides the company with information, such as the general market conditions, the mood of traders, and who is trading the stock.

- A designated market maker is one that has been selected by the exchange as the primary market maker for a given security.
- A DMM is responsible for maintaining quotes and facilitating buy and sell transactions.
- Market makers are sometimes making markets for several hundred of listed stocks at a time.
- Designated Market Makers on NYSE were previously known as specialists.
- DMMs provide a higher level of service compared to electronic trading.

Predatory Trading

Momentum Ignition

Asset Types

Bonds and Why They Trade OTC...

Bonds primarily trade OTC because of three reasons:

- First, there is a very large population of debt securities compared with equities. For example, there are 6,810 shares admitted to trading on regulated markets in the EU on 22 July 2009 whereas Xtrakter's CUPID database contains information on over 150,000 debt securities in issue.Therefore, debt markets are far less concentrated than equity markets.
- Second, the average size of a bond trade tends to be substantially greater than for an equity trade. Xtrakter data indicates that average bond trade sizes are between €1m and €2m while trades in excess of €2m - €5m are common. Prior to the crisis, even trades of €100m or more were not uncommon. The average trade size for equities on the London Stock Exchange, on the other hand, is in the region of £43,000 and European legislation defines the typical retail trade in equities as €7500 or less.
- Third, unlike equities almost all bonds trade very infrequently so there is rarely a constant supply of buyers and sellers looking to trade sufficient to sustain a central pool of investor provided liquidity. Only 3,000 of the top bonds (by volume) traded at least once a day on average. Of the top 100 bonds by volume traded the highest trade count bond traded 10,000 times in the year whilst others traded only 6 times in the year. This contrasts significantly to liquidity in the equity market. Under MiFID a share is considered to be liquid if it is traded daily, with a free float of less than EUR 500 million, and either the average daily number of transactions in the share is not less than 500 or the average daily turnover for the share is not less than EUR 2 million.

Therefore, unlike equity markets there is seldom a continuous two-way market of buyers and sellers whereby a minor change in price by one or the other can result in a trade. Instead, liquidity is provided by dealers who operate in two ways. First they put their own capital at risk by, for example, buying bonds from an investor even if they do not have a buyer to whom they can sell-on the bonds. They take the risk that in due course they will find a buyer to whom they can sell the bonds at a profit. Second, they take an order e.g. from a client who wants to buy a quantity of a particular bond and will search the market for an investor who is prepared to sell the bonds. The dealer will then seek to negotiate a price with the buyer and then seller which satisfies both clients and which enables the dealer to make a profit from the difference between the price he charges the seller and the price he charges the buyer.

Spot Markets

The spot market is where financial instruments, such as commodities, currencies, and securities, are traded for immediate delivery. Delivery is the exchange of cash for the financial instrument. A futures contract, on the other hand, is based on the delivery of the underlying asset at a future date.

Exchanges and over-the-counter (OTC) markets may provide spot trading and/or futures trading.

- Financial instruments trade for immediate delivery in the spot market.
- Many assets quote a “spot price” and a “futures or forward price.”
- Most spot market transactions have a T+2 settlement date.
- Spot market transactions can take place on an exchange or over-the-counter (OTC).
- Spot markets can be contrasted with derivatives markets that instead trade in forwards, futures, or options contracts.

Understanding Contract for Differences

CFDs allow traders to trade in the price movement of securities and derivatives. Derivatives are financial investments that are derived from an underlying asset. Essentially, CFDs are used by investors to make price bets as to whether the price of the underlying asset or security will rise or fall.

CFD traders may bet on the price moving up or downward. Traders who expect an upward movement in price will buy the CFD, while those who see the opposite downward movement will sell an opening position.

Should the buyer of a CFD see the asset's price rise, they will offer their holding for sale. The net difference between the purchase price and the sale price are netted together. The net difference representing the gain or loss from the trades is settled through the investor's brokerage account.

Conversely, if a trader believes a security's price will decline, an opening sell position can be placed. To close the position they must purchase an offsetting trade. Again, the net difference of the gain or loss is cash-settled through their account.

Transacting in CFDs

Contracts for differences can be used to trade many assets and securities including exchange-traded funds (ETFs). Traders will also use these products to speculate on the price moves in commodity futures contracts such as those for crude oil and corn. Futures contracts are standardized agreements or contracts with obligations to buy or sell a particular asset at a preset price with a future expiration date.

Although CFDs allow investors to trade the price movements of futures, they are not futures contracts by themselves. CFDs do not have expiration dates containing preset prices but trade like other securities with buy and sell prices.

CFDs trade over-the-counter (OTC) through a network of brokers that organize the market demand and supply for CFDs and make prices accordingly. In other words, CFDs are not traded on major exchanges such as the New York Stock Exchange (NYSE). The CFD is a tradable contract between a client and the broker, who are exchanging the difference in the initial price of the trade and its value when the trade is unwound or reversed.

Advantages of a CFD

CFDs provide traders with all of the benefits and risks of owning a security without actually owning it or having to take any physical delivery of the asset.

CFDs are traded on margin meaning the broker allows investors to borrow money to increase leverage or the size of the position to amply gains. Brokers will require traders to maintain specific account balances before they allow this type of transaction.

Trading on margin CFDs typically provides higher leverage than traditional trading. Standard leverage in the CFD market can be as low as a 2% margin requirement and as high as a 20% margin. Lower margin requirements mean less capital outlay and greater potential returns for the trader.

Typically, fewer rules and regulations surround the CFD market as compared to standard exchanges. As a result, CFDs can have lower capital requirements or cash required in a brokerage account. Often, traders can open an account for as little as $1,000 with a broker. Also, since CFDs mirror corporate actions taking place, a CFD owner can receive cash dividends increasing the trader's return on investment. Most CFD brokers offer products in all major markets worldwide. Traders have easy access to any market that is open from the broker's platform.

CFDs allow investors to easily take a long or short position or a buy and sell position. The CFD market typically does not have short-selling rules. An instrument may be shorted at any time. Since there is no ownership of the underlying asset, there is no borrowing or shorting cost. Also, few or no fees are charged for trading a CFD. Brokers make money from the trader paying the spread meaning the trader pays the ask price when buying, and takes the bid price when selling or shorting. The brokers take a piece or spread on each bid and ask price that they quote.

Disadvantages of a CFD

If the underlying asset experiences extreme volatility or price fluctuations, the spread on the bid and ask prices can be significant. Paying a large spread on entries and exits prevents profiting from small moves in CFDs decreasing the number of winning trades while increasing losses.

Since the CFD industry is not highly regulated, the broker's credibility is based on its reputation and financial viability. As a result, CFDs are not available in the United States.

Since CFDs trade using leverage, investors holding a losing position can get a margin call from their broker, which requires additional funds to be deposited to balance out the losing position. Although leverage can amplify gains with CFDs, leverage can also magnify losses and traders are at risk of losing 100% of their investment. Also, if money is borrowed from a broker to trade, the trader will be charged a daily interest rate amount.

Futures

Futures are derivative financial contracts that obligate the parties to transact an asset at a predetermined future date and price. The buyer must purchase or the seller must sell the underlying asset at the set price, regardless of the current market price at the expiration date. Underlying assets include physical commodities or other financial instruments. Futures contracts detail the quantity of the underlying asset and are standardized to facilitate trading on a futures exchange. Futures can be sued for hedging or trade speculation.

Understanding Futures

Futures—also called futures contracts—allow traders to lock in the price of the underlying asset or commodity. These contracts have expiration dates and set prices that are known upfront. Futures are identified by their expiration month. For example, a December gold futures contract expires in December.

Traders and investors use the term "futures" in reference to the overall asset class. However, there are many types of futures contracts available for trading including:[1]

- Commodity futures such as crude oil, natural gas, corn, and wheat
- Stock index futures such as the S&P 500 Index
- Currency futures including those for the euro and the British pound
- Precious metal futures for gold and silver
- U.S. Treasury futures for bonds and other products

It's important to note the distinction between options and futures. American-style options contracts give the holder the right (but not the obligation) to buy or sell the underlying asset any time before the expiration date of the contract; with European options, you can only exercise at expiration but do not have to exercise that right.[2]

The buyer of a futures contract, on the other hand, is obligated to take possession of the underlying commodity (or the cash equivalent) at the time of expiration and not any time before. The buyer of a futures contract can sell their position at any time before expiration and be free of their obligation. In this way, buyers of both options and futures contracts benefit from a leverage holder's position closing before the expiration date.

Options

Options are conditional derivative contracts that allow buyers of the contracts (option holders) to buy or sell a security at a chosen price. Option buyers are charged an amount called a "premium" by the sellers for such a right. Should market prices be unfavorable for option holders, they will let the option expire worthless, thus ensuring the losses are not higher than the premium. In contrast, option sellers (option writers) assume greater risk than the option buyers, which is why they demand this premium.

Options are divided into "call" and "put" options. With a call option, the buyer of the contract purchases the right to *buy* the underlying asset in the future at a predetermined price, called exercise price or strike price. With a put option, the buyer acquires the right to *sell* the underlying asset in the future at the predetermined price.

Why Trade Options Rather Than a Direct Asset?

There are some advantages to trading options. The Chicago Board of

Options Exchange (CBOE) is the largest such exchange in the world, offering options on a wide variety of single stocks, ETFs and indexes. Traders can construct option strategies ranging from buying or selling a single option to very complex ones that involve multiple simultaneous option positions.

Alternative Investing

An alternative investment is a financial asset that does not fall into one of the conventional investment categories. Conventional categories include stocks, bonds, and cash. Alternative investments include private equity or venture capital, hedge funds, managed futures, art and antiques, commodities, and derivatives contracts. Real estate is also often classified as an alternative investment.

Most alternative investment assets are held by institutional investors or accredited, high-net-worth individuals because of their complex nature, lack of regulation, and degree of risk. Many alternative investments have high minimum investments and fee structures, especially when compared to mutual funds and exchange-traded funds (ETFs). These investments also have less opportunity to publish verifiable performance data and advertise to potential investors. Although alternative assets may have high initial minimums and upfront investment fees, transaction costs are typically lower than those of conventional assets, due to lower levels of turnover.

Most alternative assets are fairly illiquid, especially compared to their conventional counterparts. For example, investors are likely to find it considerably more difficult to sell an 80-year old bottle of wine compared to 1,000 shares of Apple Inc., due to a limited number of buyers. Investors may have difficulty even valuing alternative investments, since the assets, and transactions involving them, are often rare. For example, a seller of a 1933 Saint-Gaudens Double Eagle $20 gold coin may have difficulty determining its value, as there are only 13 known to exist.

Regulation of Alternative Investments

Even when they don't involve unique items like coins or art, alternative investments are prone to investment scams and fraud due to the lack of regulations.

Alternative investments are often subject to a less clear legal structure than conventional investments. They do fall under the purview of the Dodd-Frank Wall Street Reform and Consumer Protection Act, and their practices are subject to examination by the Securities and Exchange Commission (SEC). However, they usually don't have to register with the SEC. As such, they are not overseen or regulated by the SEC or the Financial Services Regulatory Commission as are mutual funds and ETFs.

So, it is essential that investors conduct extensive due diligence when considering alternative investments. In some cases, only accredited investors may invest in alternative offerings. Accredited investors are those with a net worth exceeding $1 million—not counting their primary residence—or with an annual income of at least $200,000.

Crypto Trading

What are crypto exchanges and how do you select one?

Crypto trading (trading of cryptocurrency) happens primarily on crypto exchanges which digital marketplaces where you can buy and trade crypto.

You currently cannot buy crypto from your personal bank or investment firm. Once you have decided you want to buy some Bitcoin, Ethereum, or some other cryptocurrency, you will need to create an account on a crypto trading platform to exchange your local currency (e.g. SAR) for digital assets.

Some exchanges, such as Coinbase, have been around since the early days of Bitcoin when there was far less supervision or even concern into how cryptocurrencies were bought, sold, and traded. Others, like PayPal and Robinhood, are better-known for other services, and have only recently allowed customers to trade cryptocurrencies.

Below are just a few of the considerations you need to make when selecting the best cryptocurrency exchange for you:

- **security** some exchanges offer insurance policies to protect their customers from hacking and fraud. For example, Coinbase offers an insurance policy worth $255 million USD.
- **accessibility** is the exchange even available in your region or country? For example, China has outlawed crypto exchanges altogether. The link

below has some information about popular crypto exchanges in Saudi Arabia:
Popular KSA Crypto Exchanges

- **coins offered** the bottom line here is that not every crypto exchange offers every coin. So if you are looking to buy anything other than Bitcoin or Ethereum, make sure the exchange you are considering supports the coin you are considering purchasing.
- **transaction fees** you need to do your homework on this one because higher fees are not necessarily a bad thing - as higher fees are typically assessed if the exchange makes it easier for you to purchase cryptocurrency.

What are the differences between crypto exchanges and traditional exchanges?

Below are some of the basic differences between traditional exchanges and crypto exchanges:

- Crypto exchanges typically offer several services including order matching, account verification, and transaction processing while traditional exchanges typically offer only one service - carrying out trades through an order matching service
- Crypto exchanges typically offer their APIs for free while traditional exchanges typically charge for access to their APIs
- Traditional financial exchanges still often rely on massive physical data centers where crypto exchanges rely almost exclusively on the cloud

Analysis: Technical, Fundamental & Sentiment

Objectives:

- Students will be able to differentiate the differences amongst technical analysis, fundamental analysis and sentiment analysis.
- Students will be able to describe the technical indicators associated with the technical analysis.
- Students will be able to discuss the importance of the LOB (limit order book).
- Students will be able to explain what tools are used for functional analysis.
- Students will be able to explain how sentiment analysis is used for predicting stock prices.

Technical Analysis

Technical analysis is a tool, or method, used to predict the probable future price movement of a security – such as a stock or currency pair – based on market data.

The theory behind the validity of technical analysis is the notion that the collective actions – buying and selling – of all the participants in the market accurately reflect all relevant information pertaining to a traded security, and therefore, continually assign a fair market value to the security.

Technical traders believe that current or past price action in the market is the most reliable indicator of future price action.

Technical analysis is not only used by technical traders. Many fundamental traders use fundamental analysis to determine whether to buy into a market, but having made that decision, then use technical analysis to pinpoint good, low-risk buy entry price levels.

Technical traders analyze price charts to attempt to predict price movement. The two primary variables for technical analysis are the time frames considered and the particular technical indicators that a trader chooses to utilize.

The technical analysis time frames shown on charts range from one-minute to monthly, or even yearly, time spans. Popular time frames that technical analysts most frequently examine include:

- 5-minute chart
- 15-minute chart
- Hourly chart
- 4-hour chart
- Daily chart

The time frame a trader selects to study is typically determined by that individual trader's personal trading style. Intra-day traders, traders who open and close trading positions within a single trading day, favor analyzing price movement on shorter time frame charts, such as the 5-minute or 15-minute charts. Long-term traders who hold market positions overnight and for long periods of time are more inclined to analyze markets using hourly, 4-hour, daily, or even weekly charts.

Price movement that occurs within a 15-minute time span may be very significant for an intra-day trader who is looking for an opportunity to realize a profit from price fluctuations occurring during one trading day. However, that same price movement viewed on a daily or weekly chart may not be particularly significant or indicative for long-term trading purposes.

It's simple to illustrate this by viewing the same price action on different time frame charts. The following daily chart for silver shows price trading within the same range, from roughly $16 to $18.50, that it's been in for the past several months. A long-term silver investor might be inclined to look to buy silver based on the fact that the price is fairly near the low of that range.

However, the same price action viewed on an hourly chart (below) shows a steady downtrend that has accelerated somewhat just within the past several hours. A silver investor interested only in making an intra-day trade would likely shy away from buying the precious metal based on the hourly chart price action.

Technical Indicators - Moving Averages

In addition to studying candlestick formations, technical traders can draw from a virtually endless supply of technical indicators to assist them in making trading decisions.

Moving averages are probably the single most widely-used technical indicator. Many trading strategies utilize one or more moving averages. A simple moving average trading strategy might be something like, "Buy as long as price remains above the 50-period exponential moving average (EMA); Sell as long as price remains below the 50 EMA".

Moving average crossovers are another frequently employed technical indicator. A crossover trading strategy might be to buy when the 10-period moving average crosses above the 50-period moving average.

The higher a moving average number is, the more significant price movement in relation to it is considered. For example, price crossing above or below a 100- or 200-period moving average is usually considered much more significant than price moving above or below a 5-period moving average.

Technical Indicators - Pivots and Fibonacci Numbers

Daily pivot point indicators, which usually also identify several support and resistance levels in addition to the pivot point, are used by many traders to identify price levels for entering or closing out trades. Pivot point levels often mark significant support or resistance levels or the levels where trading is contained within a range. If trading soars (or plummets) through the daily pivot and all the associated support or resistance levels, this is interpreted by many traders as "breakout" trading that will shift market prices substantially higher or lower, in the direction of the breakout.

Daily pivot points and their corresponding support and resistance levels are calculated using the previous trading day's high, low, opening and closing prices. I'd show you the calculation, but there's really no need, as pivot point levels are widely published each trading day and there are pivot point indicators you can just load on a chart that do the calculations for you and reveal pivot levels. Most pivot point indicators show the daily pivot point along with three support levels below the pivot point and three price resistance levels above it.

Technical Indicators - Momentum Indicators

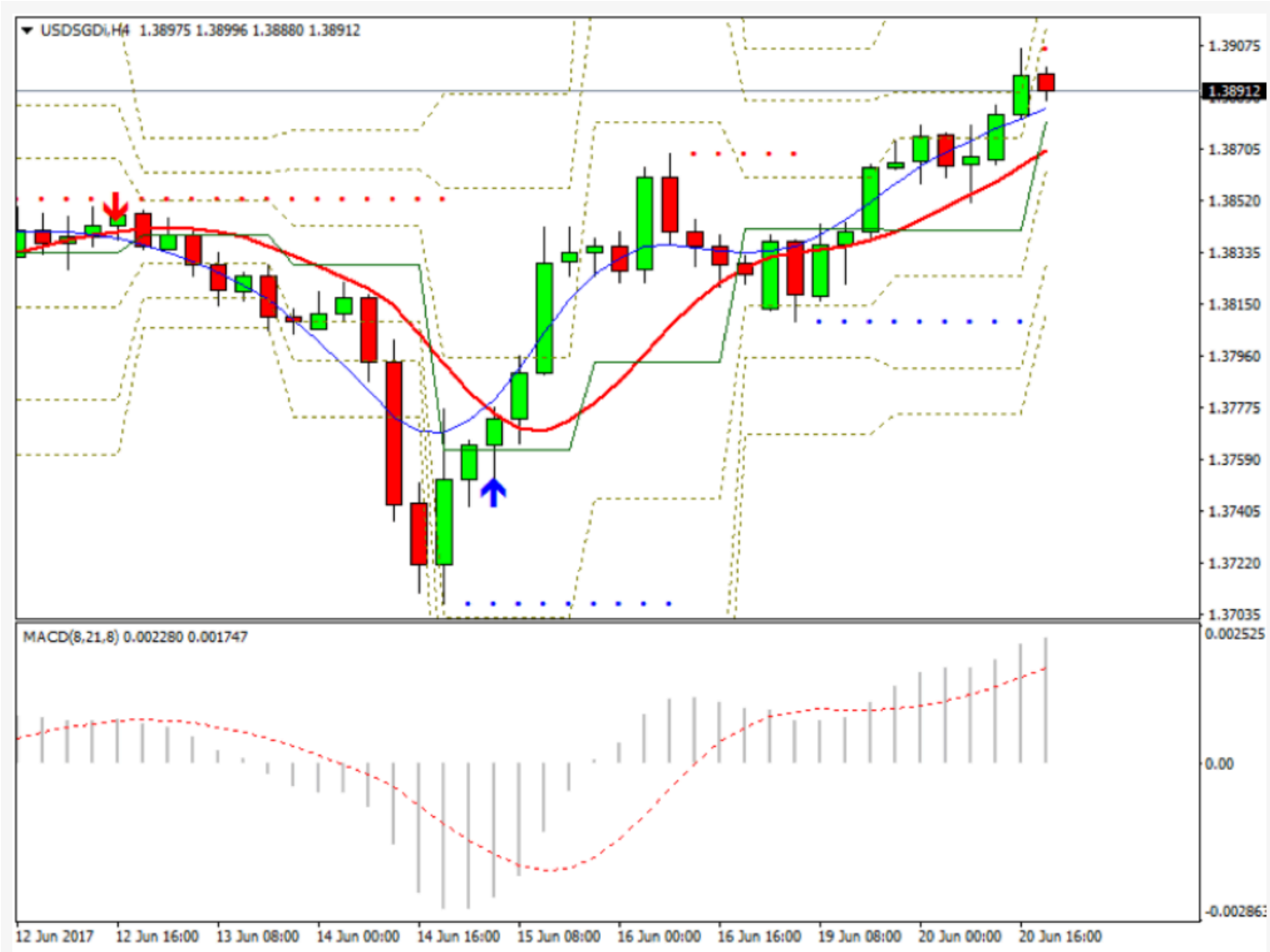
Moving averages and most other technical indicators are primarily focused on determining likely market direction, up or down.

There is another class of technical indicators, however, whose main purpose is not so much to determine market *direction* as to determine market *strength*. These indicators include such popular tools as the Stochastic Oscillator, the Relative Strength Index (RSI), the Moving Average Convergence-Divergence (MACD) indicator, and the Average Directional Movement Index (ADX).

By measuring the strength of price movement, momentum indicators help investors determine whether current price movement more likely represents relatively insignificant, range-bound trading or an actual, significant trend. Because momentum indicators measure trend strength, they can serve as early warning signals that a trend is coming to an end. For example, if a security has been trading in a strong, sustained uptrend for several months, but then one or more momentum indicators signals the trend steadily losing strength, it may be time to think about taking profits.

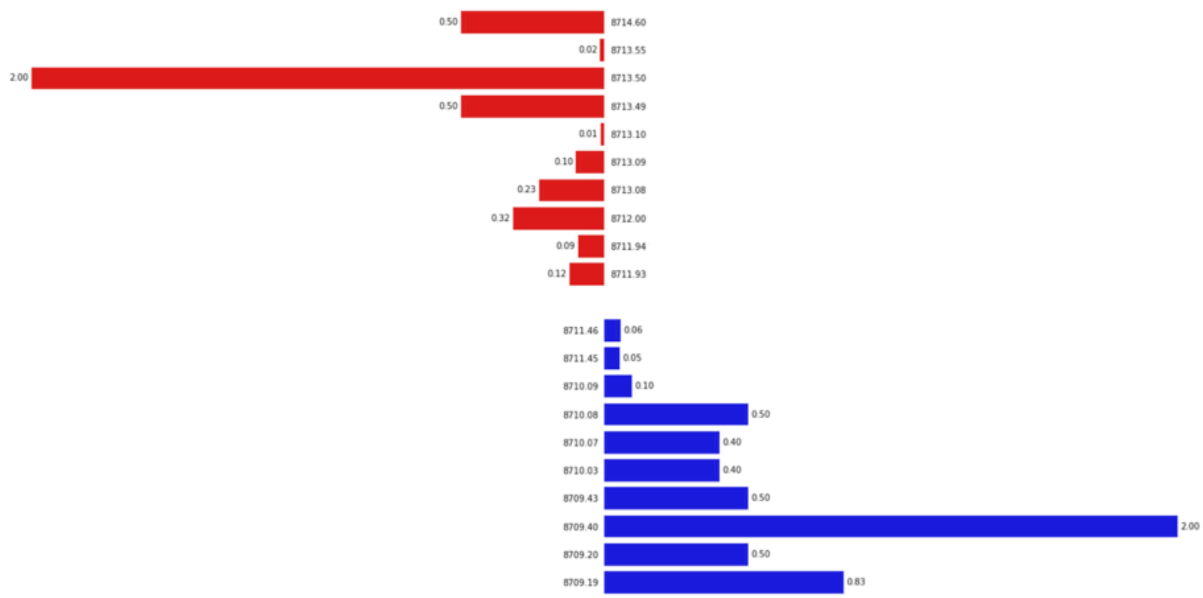
The 4-hour chart of USD/SGD below illustrates the value of a momentum indicator. The MACD indicator appears in a separate window below the main chart window. The sharp upturn in the MACD beginning around June 14th indicates that the corresponding upsurge in price is a strong, trending move rather than just a temporary correction. When price begins to retrace downward somewhat on the 16th, the MACD shows weaker price action, indicating that the downward movement in price does not have much strength behind it. Soon after that, a strong uptrend resumes. In this instance, the MACD would have helped provide reassurance to a buyer of the market that (A) the turn to the upside was a significant price move and (B) that the uptrend was likely to resume after price dipped slightly on the

16th.



Because momentum indicators generally only signal strong or weak price movement, but not trend direction, they are often combined with other technical analysis indicators as part of an overall trading strategy.

Limit Order Book (LOB)



A limit order book is a record of outstanding limit orders maintained by the security specialist who works at the exchange. A limit order is a type of order to buy or sell a security at a specific price or better. A buy limit order is an order to buy at a preset price or lower while a sell limit order is an order to sell a security at a pre-specified price or higher.

When a limit order for a security is entered, it is kept on record by the security specialist. As buy and sell limit orders for the security are given, the specialist keeps a record of all these orders in the order book. The specialist executes the orders at or better than the given limit price when the market moves to the pre-specified price.

The specialist running the limit order book has the responsibility to guarantee that the top priority order is executed before other orders in the book, and before other orders at an equal or worse price held or submitted by other traders on the floor, such as floor brokers and market makers.

The specialist earns a profit from the spread between the difference in prices between the bid and ask orders on their book as they execute the orders. With the advancements in trading system technologies, the process has shifted from a manual process to one that is largely automated.

In 2000, the Securities and Exchange Commission (SEC) began to create a centralized limit order book that keeps track of limit orders on exchanges electronically.1 This electronic order tracking system automatically matches for the execution of the best possible pair of orders in the system. The best pair is made up of the highest bid, and the lowest ask orders. The bid is the price the specialist or exchange will sell a security or the price at which an investor can buy the security. The ask or offer is the price at which the specialist or exchange will buy a security or the price at which the investor can sell the security.

When a limit order is entered into a trading system and fielded by either a specialist working the book or an electronic database of orders, it will stay on the books until it can be matched with a suitable trade and executed. Buy limit orders are placed with an upper price threshold. The investor would say "I don't want to pay more than $X for this share." Sell limit orders are placed with a lower price threshold. The investor would say "I don't want to sell this share for less than $X."

For a more detailed description click on limit order book.

Thinkorswim by TD Ameritrade

An electronic trading platform used to trade financial assets. It is geared for self-directed stock, options and futures traders which was previously offered by ThinkorSwim Group, Inc and was purchased by TD Ameritrade in 2009.

It provides services for self-directed option traders and institutional users who invest in equities, exchange-traded funds, futures, mutual funds and bonds.

Thinkorswim provides financial literacy services for self-directed investors including trading tools and analytics. It offers a range of investor education products in a variety of interactive delivery formats, including instructor-led synchronous and asynchronous online courses, in-person workshops, one-on-one and one-to-many online coaching programs and telephone, live-chat and email support. Thinkorswim is used in conjunction with trades of equity securities, fixed income, index products, options, futures, other derivatives and foreign exchange. The Thinkorswim software is provided free for account holders of TD Ameritrade and trades via the TD Ameritrade platform are free.

JPM eFX DNA "Deep Neural Network for Algo Execution"

J.P. Morgan is taking technology to a new level in the foreign exchange market, applying machine learning to provide competitive pricing and optimize execution in what is already one of the most liquid and automated asset classes alongside equities. The Deep Neural Network for Algo Execution (DNA) is J.P. Morgan's latest tool to enhance its FX algorithms and uses a machine learning framework to bundle certain existing algos into one streamlined execution strategy.

“DNA is an optimization feature that leverages simulated data from various types of market conditions to select the best order placement and execution style designed to minimize market impact," said Chi Nzelu, head of Macro eCommerce at J.P. Morgan. “It then uses reinforcement learning – a subset of machine learning – to assess the performance of individual order placement choices."

[Read more...]

Oscillators

An oscillator is a technical analysis tool that constructs high and low bands between two extreme values, and then builds a trend indicator that fluctuates within these bounds. Traders use the trend indicator to discover short-term overbought or oversold conditions. When the value of the oscillator approaches the upper extreme value, technical analysts interpret that information to mean that the asset is overbought, and as it approaches the lower extreme, technicians consider the asset to be oversold.

The Relative Strength Index is arguably the most popular technical indicator when it comes to trading. But being popular doesn’t always make you right or easy. David Jones knows this and is here to give a helping hand to those just starting their journey in the world of the markets, as well as those who’ve had a bit more experience.

Order Flow

Order flow defines the amount of orders waiting to be executed at a certain price level.

While the price is rising upward in a very strong rally, we know for certain that it will eventually stop somewhere. The rally up happens because there are simply more traders willing to buy than traders that are willing to sell. This creates an imbalance between buyers and sellers, whereas there are more buyers demanding the supply, therefore price shifts upwards. Eventually, the buyer momentum will end and the price will be driven up to a level where there are more sellers than buyers. This new imbalance created by more sellers than buyers will push price downwards.

This simple scenario is what happens in the markets on the macro and micro levels. This is the essence of what makes price move range or reverse.

When you look at a chart of a moving price and interpret this to the forces balance placed on different price levels.

Take a deeper look at Order Flow and VPIN here.

Tools for a Fundamental Analysis

Cross-Sectional Analysis

Cross-sectional analysis is a type of analysis where an investor, analyst or portfolio manager compares a particular company to its industry peers. Cross-sectional analysis may focus on a single company for head-to-head analysis with its biggest competitors or it may approach it from an industry-wide lens to identify companies with a particular strength.

Cross-sectional analysis is often deployed in an attempt to assess performance and investment opportunities using data points that are beyond the usual balance sheet numbers.

When conducting a cross-sectional analysis, the analyst uses comparative metrics to identify the valuation, debt-load, future outlook and/or operational efficiency of a target company. This allows the analyst to evaluate the target company's efficiency in these areas, and to make the best investment choice among a group of competitors within the industry as a whole.

Analysts implement a cross-sectional analysis to identify special characteristics within a group of comparable organizations, rather than to establish relationships. Often cross-sectional analysis will emphasize a particular area, such as a company's war chest, to expose hidden areas of strength and weakness in the sector. This type of analysis is based on information-gathering and seeks to understand the "what" instead of the "why." Cross-sectional analysis allows a researcher to form assumptions, and then test their hypothesis using research methods.

AQR - How It Places Bets Against Beta

AQR, a large hedge fund founded by famed investor Cliff Asness, uses a strategy of statistical arbitrage by taking a short position in stocks with high beta and a long position in stocks with a low beta. This strategy is known as a bet against beta. The theory is based on alleged inefficiencies with the capital asset pricing model, or CAPM, due to large funds being constrained in the type of leverage they can utilize and the risk they can take.1 Beta is a statistical measure of the risk of an individual stock or portfolio against the market as a whole. The phrase bet against beta was coined from a few economics papers written by the creators of the strategy.

Beta is a measure of the risk that cannot be reduced by diversification. A beta of one means a stock or portfolio moves exactly in step with the larger market. A beta greater than one indicates an asset with higher volatility tends to move up and down with the market. A beta of less than one indicates an asset less volatile than the market or a higher volatility asset not correlated with the larger market. A negative beta shows an asset moves inversely to the overall market. Some derivatives such as put options have consistently negative betas.

CAPM is a model that calculates the expected return on an asset or portfolio. The formula determines the expected return as the prevailing risk-free rate plus the return of the market minus the risk-free rate times the beta of the stock. The security market line, or SML, is a result of CAPM. It shows an expected rate of return as a function of non-diversifiable risk. The SML is a straight line that shows the risk-return tradeoff for an asset. The slope of the SML is equal to the market risk premium. The market risk premium is the difference between the expected return on a market portfolio and the risk-free rate.

The basic bet against beta strategy is to find assets with higher betas and take a short position in them. At the same time, a leveraged long position is taken in assets with lower betas. The idea is the higher beta assets are overpriced and the lower beta assets are underpriced. The theory posits the prices of the stocks eventually come back into line with each other. This is essentially a statistical arbitrage strategy with the prices of the assets coming back to the median price versus risk. This median is defined as the SML.

A main tenet of CAPM is all reasonable investors invest their money in a portfolio with the highest expected excess return per unit of risk. The expected excess return per unit of risk is known as the Sharpe ratio. The investor can then leverage or reduce this leverage based on his individual risk preferences. However, many large mutual funds and individual investors are constrained in the amount of leverage they can use. As a result, they have a tendency to overweight their portfolios toward higher beta assets to improve returns.

This tilting toward higher beta stocks indicates these assets require lower risk-adjusted returns versus lower beta assets. Essentially, some experts believe the slope of the SML line is too flat for the U.S. market versus CAPM.1 This allegedly creates a pricing anomaly in the market in which some attempt to profit. Some economic papers doing historical backtesting have shown superior Sharpe ratios versus the market as a whole.

In examining this phenomenon, AQR has constructed market-neutral betting against beta factors that can be used to measure this idea.1 As a practical matter, the performance of this strategy suffers due to commissions and other trading expenses.3

As such, it may not be useful for individual investors. The strategy likely requires a large amount of capital and access to low trading costs to be successful.

Sentiment Analysis

A Social Sentiment Indicator

A social sentiment indicator analyzes aggregated social media data to help b
usinesses understand how they are performing in the eyes of consumers. So
cial sentiment indicators enable companies to discover what they are doing r
ight and how they might improve.
These measures can also give investors an idea of how publicly listed stocks

might perform. Social Sentiment should not be confused with market sentiment indicators, which are designed to represent how a group or population feels about the overall market or economy. Keeping customers cheerful is paramount for companies targeting long-term success. When the public is happy with a service or product, and all its other interactions with the provider, company revenues profits are more likely to rise.

In the digital age, it has become much easier for companies and investors to gauge how well businesses are treating their customers. Social sentiment indicators can tell us a lot about the public perception of a company, at least in terms of what is being said on social media.

These indicators extract information users post publicly to Facebook, Twitter, blog posts, discussion groups, and forums. If the social sentiment indicator shows a negative change in reputation, the company might be able to address the problem before it grows and starts potentially heavily weighing on its share price.

The Advantages of Social Sentiment Indicators

Social sentiment indicators serve a variety of purposes. Companies might blame social media for triggering a rise in complaints and encouraging hate campaigns. However, these same firms can use the internet and social sentiment indicators to their advantage, too, including in the following ways:

- Identify trends to target new customers
- Develop successful marketing campaigns and gauge if they are spending marketing dollars wisely
- Determine how consumers feel about competitors and similar products
- Assess what to expand on and what to drop or change
- Protect and improve their brand identity and image

Social sentiment indicators are also helping to reduce the burden on customer service email and call centers. Nowadays, it is possible to address questions and problems en masse via social media. In some cases, these communication methods might even be used to reach out to highly influential individuals with a track record of swaying sentiment on popular chat platforms.

Investors, too, can benefit from social sentiment indicators because the type of information that they collate tends to have a bearing on stock prices. If an investor spots that people on social media have suddenly started to complain about a particular company, they could opt to sell before the rest of the market reacts. Value investors, on the other hand, might use these tools to buy into a stock that they believe has been excessively punished by internet gossip.

Third-Party Information Can Enhance Data Analytics

Using third-party data sources can be challenging, but it is crucial for companies who want to gain an analytics edge to tap into data ecosystems. Analyzing external data can help companies see the risks and opportunities that they would miss with inputs limited to data generated from internal operations, customers, and first-tier suppliers.

According to one study, the data stored in data centers will nearly quintuple by 2021, reaching 1.3 zettabytes globally. Along with the volume of data available, the potential value of analyzing this data grows bigger by the day.

It's not surprising that companies on the leading edge of data and analytics are more likely to make use of external data. An MIT Sloan Management Review report published last year found that the companies making the most innovative use of data and analytics were more likely than others to leverage more external data sources, including social, mobile, and publicly available data.

Marketing offers, improved HR processes and new revenue streams gained from new products and services and anticipated shifts in demand are influenced by external data sources. Models have been built from data sourced from third party data to predict the best types of customers to market to with the appropriate campaigns. Several startups monitor data from social networks to predict job-seeking behavior and retention risk.

Size of the data and the complexity of how the data was obtained are challenges for those using external data. Other challenges of using external data include the refresh rate of the data, usage restrictions, if shared revenue is an expectation of the vendor and contractual agreements with the vendor.

Algorithmic Trading Basics

Objectives:

- Students will be able to explain what sets of instructions are used with algorithmic trading basics.
- Students will be able to grasp an understanding of the benefits of algorithmic trading.
- Students will be able to define systematic trading and discretionary trading.
- Students will gain an understanding the differences in systematic trading and discretionary trading.
- Students will be able to describe the Fundamental Law of Active Management.
- Students will be able to define the Information Ratio Formula and how it relates to the Fundamental Law of Active Management.
- Students will be able to provide a description of the Sharpe Ratio and why it is used.
- Students will be able to define and have an understanding the application of diversification.

Algorithmic Trading Basics

Algorithmic trading (also called automated trading, black-box trading, or algo-trading) uses a computer program that follows a defined set of instructions (an algorithm) to place a trade. The trade, in theory, can generate profits at a speed and frequency that is impossible for a human trader.

The defined sets of instructions are based on timing, price, quantity, or any mathematical model. Apart from profit opportunities for the trader, algo-trading renders markets more liquid and trading more systematic by ruling out the impact of human emotions on trading activities.

Algorithmic Trading in Practice

Suppose a trader follows these simple trade criteria:

- Buy 50 shares of a stock when its 50-day moving average goes above the 200-day moving average. (A moving average is an average of past data points that smooths out day-to-day price fluctuations and thereby identifies trends.)
- Sell shares of the stock when its 50-day moving average goes below the 200-day moving average.

Using these two simple instructions, a computer program will automatically monitor the stock price (and the moving average indicators) and place the buy and sell orders when the defined conditions are met. The trader no longer needs to monitor live prices and graphs or put in the orders manually. The algorithmic trading system does this automatically by correctly identifying the trading opportunity.

Benefits of Algorithmic Trading

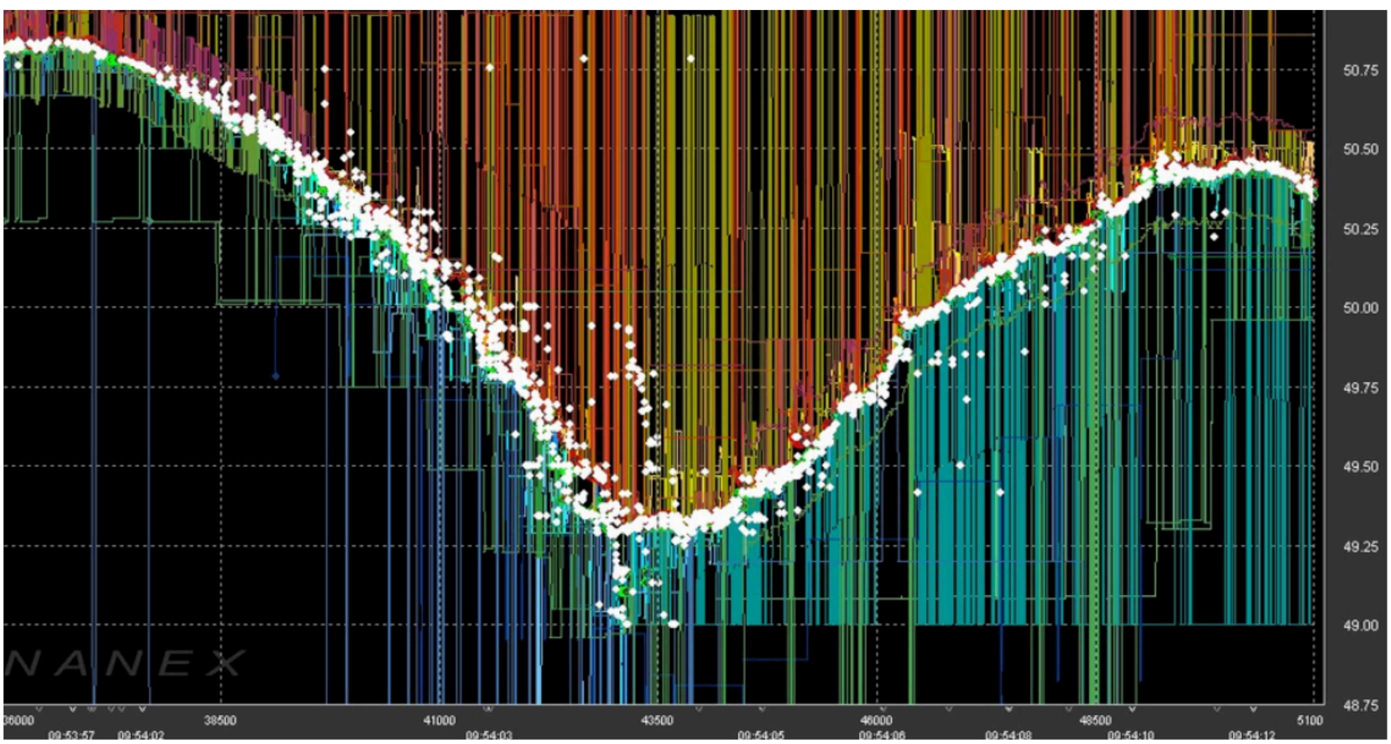
Algo-trading provides the following benefits:

- Trades are executed at the best possible prices.
- Trade order placement is instant and accurate (there is a high chance of

execution at the desired levels).

- Trades are timed correctly and instantly to avoid significant price changes.
- Reduced transaction costs.
- Simultaneous automated checks on multiple market conditions.
- Reduced risk of manual errors when placing trades.
- Algo-trading can be backtested using available historical and real-time data to see if it is a viable trading strategy.
- Reduced the possibility of mistakes by human traders based on emotional and psychological factors.

Most algo-trading today is high-frequency trading (HFT), which attempts to capitalize on placing a large number of orders at rapid speeds across multiple markets and multiple decision parameters based on preprogrammed instructions.



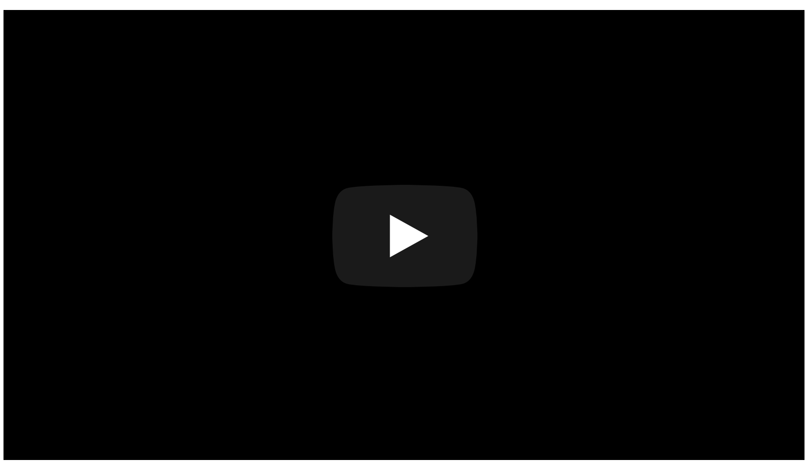
Algo-trading is used in may forms of trading and investment activities including:

- Mid to long-term-investors or buy-side firms - pension funds, mutual funds, insurance companies-use algo-traidng to purchase stocks in large quantities when they do no want to influence stock prices with discrete, large-volume investments.

- Short-term traders and sell-side participants - market makers (such as brokerage houses), speculators, and arbitrageurs - benefit from automated trade execution; in addition, algo-trading aids in creating sufficient liquidity for sellers in the market.
- Systematic traders—trend followers, hedge funds, or pairs traders (a market-neutral trading strategy that matches a long position with a short position in a pair of highly correlated instruments such as two stocks, exchange-traded funds (ETFs) or currencies)—find it much more efficient to program their trading rules and let the program trade automatically.

Algorithmic trading provides a more systematic approach to active trading than methods based on trader intuition or instinct.

Discretionary Trading vs. Systematic Trading



When an investor enters the Managed Futures space, two of the first terms that he/she hears is “systematic” and “discretionary.” Those are the two most frequently used expressions when it comes to describing a Commodity Trading Advisor’s (CTA) investment strategy. As a new Managed Futures investor, it’s important to understand the differences between the two to fully comprehend the potential benefits and pit-falls of each.

A systematic trader or CTA is one that relies solely on signals produced by a computer program or model. Many times, these signals can consist of technical analysis (recognizing patterns or trends in historical charts) of market data, or fundamental analysis of economic data, to identify and make trades, with limited or no human intervention. Since all trades are being provided be a “computer,” all human emotions are removed from the trading process allowing for the most unbiased form of investing. The downside to systematic strategies is that because they are so carefully designed and programmed, it can take a long period of time to make changes to them. Therefore, if certain market or economic conditions change over time, a system may not be able to adapt to the new conditions and require some “tweaks” and changes.

On the other end of the spectrum from Systematic trading, is discretionary trading. As the name suggests, discretionary trading advisors’ investment decisions are all made by a human-being. All trading decisions are made based on real-time market data, and it is ultimately the trader’s discretion to decide which market to trade, when to trade, and how much to risk. While discretionary CTAs have the ability to immediately react to changing market conditions, they also have to battle their own emotions when picking a trade to enter. While this may be good in certain instances, in other instances it may lead to a bad trade being selected or a good trade being missed.

Expected Return

Expected return measures the mean, or expected value, of the probability distribution of investment returns. The expected return of a portfolio is calculated by multiplying the weight of each asset by its expected return and adding the values for each investment.

For example, a portfolio has three investments with weights of 35% in asset A, 25% in asset B, and 40% in asset C. The expected return of asset A is 6%, the expected return of asset B is 7%, and the expected return of asset C is 10%.

Asset	Weight	Expected Return
A	35%	6%
B	25%	7%
C	40%	10%

Therefore, the expected return of the portfolio is

[(35% * 6%) + (25% * 7%) + (40% * 10%)] = 7.85%

This is commonly seen with hedge fund and mutual fund managers, whose performance on a particular stock isn't as important as their overall return for their portfolio.

Standard Deviation

Conversely, the standard deviation of a portfolio measures how much the investment returns deviate from the mean of the probability distribution of investments.

The standard deviation of a two-asset portfolio is calculated as:

$\sigma_P = \sqrt{(w_A^2 * \sigma_A^2 + w_B^2 * \sigma_B^2 + 2 * w_A * w_B * \sigma_A * \sigma_B * \rho_{AB})}$

Where:

- σ_P = portfolio standard deviation
- w_A = weight of asset A in the portfolio
- w_B = weight of asset B in the portfolio
- σ_A = standard deviation of asset A
- σ_B = standard deviation of asset B; and
- ρ_{AB} = correlation of asset A and asset B

For example, consider a two-asset portfolio with equal weights, standard deviations of 20% and 30%, respectively, and a correlation of 0.40. Therefore, the portfolio standard deviation is:

$$[\sqrt{(0.5^2 * 0.2^2 + 0.5^2 * 0.3^2 + 2 * 0.5 * 0.5 * 0.2 * 0.3 * 0.4)}] = 21.1\%$$

Standard deviation is calculated to judge the realized performance of a portfolio manager. In a large fund with multiple managers with different styles of investing, a CEO or head portfolio manager might calculate the risk of continuing to employ a portfolio manager who deviates too far from the mean in a negative direction. This can go the other way as well, and a portfolio manager who outperforms their colleagues and the market can often expect a hefty bonus for their performance.

Sharpe Ratio

The Sharpe ratio was developed by Nobel laureate William F. Sharpe and is used to help investors understand the return of an investment compared to its risk. The ratio is the average return earned in excess of the risk-free rate per unit of volatility or total risk. Volatility is a measure of the price fluctuations of an asset or portfolio.

Formula and Calculation of Sharpe Ratio

$$Sharpe\ Ratio = \frac{R_p - R_f}{\sigma_p}$$

R_p = Return of portfolio

R_f = Risk-Free rate

σ_p = Standard deviation of portfolio's excess return

The Sharpe ratio is calculated as follows:

1. Subtract the risk-free rate from the return of the portfolio. The risk-free rate could be a U.S. Treasury rate or yield, such as the one-year or two-year Treasury yield.
2. Divide the result by the standard deviation of the portfolio's excess return. The standard deviation helps to show how much the portfolio's return deviates from the expected return. The standard deviation also sheds light on the portfolio's volatility.

[redacted]

The Sharpe ratio can be used either to calculate past performance or expected performance in the future, using expected return and the expected risk-free rate.

To put this into an example, let us assume that an investor is planning to add a fund to a portfolio that has a return of 12% over the past year and has a current risk-free rate of 3%. The volatility of the returns was 11%:

Sharpe ratio = (12% - 3%) / 11% = 81.8% or 0.8

By adding in the new fund, the investor expects the portfolio to see its return fall to 9%, but the volatility to also fall, to 6%. If the risk-free rate remains the same, then the calculation is as follows:

Sharpe ratio = (9% - 3%) / 6% = 100% or 1

While the returns are lower, the Sharpe ratio has improved, so on a risk-adjusted basis the returns have also improved.

Essentially, the Sharpe ratio is used to determine whether the higher risk of some investments is justified. If a portfolio has higher returns, but with higher risk, it is debatable whether those risks are justified.

In general, the higher the Sharpe ratio, the more attractive a portfolio is. A Sharpe ratio of 1 is good, 2 is even better and anything 3 or above is very good.

Essentially, the ratio shows how much excess return you are receiving in return for the extra volatility endured as the 'price' for holding a riskier asset.

Portfolios that have a higher return, but also come with significantly higher risk, are not necessarily the best portfolio for an investor. Both traders and investors should think of volatility as the price they pay for holding assets with potentially large returns. As in most things in life, there is no 'free lunch' in markets, and higher returns usually imply higher volatility as well.

It is up to each investor to determine whether they are happy to bear the potential risk for the higher return. This is a matter of personal preference.

Can the Sharpe ratio be negative?

A negative Sharpe ratio either means that the risk-free rate is greater than the portfolio's return, or that the expected return is likely to be negative. A negative Sharpe ratio conveys little in the way of useful information.

The Sharpe ratio vs The Treynor ratio

The Treynor ratio is also known as the reward-to-volatility measure. While the Sharpe ratio looks at portfolio's return against the rate of return for a risk-free investment, the Treynor ratio looks at the portfolio against a benchmark, for example for S&P 500.

For example, a portfolio that has a return of 13%, versus an overall stock market return of 10%, will only be measured on the 3% it actually delivered over the broader market's performance. It is useful for determining whether a carefully constructed portfolio is actually performing more effectively than a simple tracker.

Information Ratio Formula

To produce the Information Ratio (IR), the manager's skillset is expressed by the Information Coefficient $(IC)^2$. The extent of skill application is expressed as Breadth, which is the manager's derived independent signals. The formula is given below:

IR = IC*$\sqrt{}$Breadth

Where:

- **IC** is the Information Coefficient
- **Breadth** is the number of investment decisions in a year

In the equation, the risk is the input, the strategy's productivity is IR, and the value-added is the output. At a particular risk level, the value-added should be the specified risk multiplied by the IR. Therefore, the active manager needs to increase the frequency of utilizing his/her skills at work, which is positive Breadth, or he/she can increase the quality of his/her skill set, which is positive IC.

Transaction Costs

Information Coefficient (IC) can be defined as the level of correlation in a forecast with returns realized. The correlation shows how good a manager is at forecasting. The higher the correlation, the better a manager is rated in their forecasting ability. Forecasting, however, is just the tip of the iceberg in rating a manager's ability. Transaction costs determine a manager's success rating in a portfolio.

Transaction costs offset profits realized in a successful campaign in forecasting. However, they reduce the bets available for the manager to undertake. Such circumstances of reduction tend to make rather skillful managers fail in their forecasting campaigns, especially in asset management.

Transaction costs are a vital concern for an active manager. He/She is interested in the net in transaction costs that have been realized in that instance. Managers who take transaction costs into account while maximizing IC are successful in maximizing IR. The alpha obtained in a skilled forecast can be much less than the ones measured in IC due to the presence of transaction costs.

An adjustment of the IC is prudent for the proper presentation of the fundamental law equation to reflect the prioritized bets that the manager needs to act upon. The prioritized bets should be those that have more forecasted returns than the transaction costs projected.

Fundamental Law of Active Management

The Fundamental Law of Active Management by Grinold and Kahn is designed to assess the value of active management, as expressed by the information ratio, using only two variables. The first variable is the portfolio manager 'skill' in selecting securities. In other words, how well is the portfolio manager at forming correct predictions? The second variable is breadth; the number of independent investment opportunities.

$$IR = IC \times \sqrt{N}$$

IR= information ratio

IC= information coefficient or selection skill

N= number of independent investment opportunities

If two portfolio managers have the same investment skills but one manager follows an investment strategy that relies on a higher level of breadth compared to the second manager, the first manager is more likely to outperform. The analogy can be made to the game of roulette in a casino. If the wheel spins 100 times and at each spin the player's bet is EUR 1, the expected return is the same as when the wheel spins only once and the bet is EUR 100. But for 'the house', the first option is far more preferable, because the level of breadth is higher and it offers a better reward-risk ratio.

The quantitative equity strategies we offer at Robeco benefit from the implications that follow from this formula. First, the 'skill' lies in years of our in-house research on equity markets and investor behavior. This resulted in our Quantitative Stock Selection Models which are designed to systematically identify and exploit market inefficiencies arising as a result of predictable patterns in investor behavior. Second, the level of breadth is high since we can use our models to analyze thousands of stocks in only a short period of time.

Let's take Robeco Emerging Markets Enhanced Index Equities as an example. The individual stock exposures are only 20 bps versus the benchmark, whereas a traditional portfolio manager can have an individual active weights of 300 bps or even more. However, since the individual active weights of Emerging Markets Enhanced Index Equities are small, the number of positions is in the hundreds and the level of breadth thus is high.

The combination of having a well-developed stock selection model with using a high level of breadth has led to a consistently strong track record for our Emerging Markets Enhanced Index Equities strategy (3 years = 1.24; and 5 years = 0.78, since inception= 1.27, as of end of March 2018).

Weaknesses in the Fundamental Law of Active Management

The simplicity of the law exposes it to a lot of weaknesses. For example, most of the assumptions in the law prove to be an omission. The equation seems to have been developed in the absence of transaction costs. When the transaction cost is put into perspective, there arises the urgent need to redefine Breadth and IC. Breadth should be taken into account for a complete equation and should not be influenced by other factors. However, independence cannot be precisely measured without an estimation error.

So, the equation conceals technical activities, such as asset allocation, and it can be difficult since the results will be inaccurate. The formula also ignores important portfolio considerations as it takes the expected IR of each manager in isolation.

Information Ratio does not need to show a correlation with the rest of the portfolio. When IR is uncorrelated to the rest of the portfolio, even a negative value can contribute positively to the portfolio.

Diversification

Diversification is a technique that reduces risk by allocating investments across various financial instruments, industries, and other categories. It aims to maximize returns by investing in different areas that would each react differently to the same event.

Most investment professionals agree that, although it does not guarantee against loss, diversification is the most important component of reaching long-range financial goals while minimizing risk. Here, we look at why this is true and how to accomplish diversification in your portfolio.

Let's say you have a portfolio that only has airline stocks. Share prices will drop following any bad news, such as an indefinite pilot strike that will ultimately cancel flights. This means your portfolio will experience a noticeable drop in value.

You can counterbalance these stocks with a few railway stocks, so only part of your portfolio will be affected. In fact, there is a very good chance that these stock prices will rise, as passengers look for alternative modes of transportation.

You could diversify even further because of the risks associated with these companies. That's because anything that affects travel will hurt both industries. Statisticians may say that rail and air stocks have a strong correlation. This means you should diversify across the board—different industries as well as different types of companies. The more uncorrelated your stocks are, the better.

Be sure to diversify among different asset classes, too. Different assets such as bonds and stocks don't react the same way to adverse events. A combination of asset classes like stocks and bonds will reduce your portfolio's sensitivity to market swings because they move in opposite directions. So if you diversify, unpleasant movements in one will be offset by positive results in another.

And don't forget location, location, location. Look for opportunities beyond your own geographical borders. After all, volatility in the United States may not affect stocks and bonds in Europe, so investing in that part of the world may minimize and offset the risks of investing at home.

Trading APIs Interactions

Objectives:

- Students will be able to describe how to utilize APIs in FinTech.
- Students will gain an understanding of the benefits of APIs.
- Students will be able to differentiate the differences between APIs and API-led connectivity builds.

APIs in FinTech

Financial technology refers to the new breed of companies that provide financial services and products through the use of high-tech, computer-based systems. The FinTech sector is one of the most rapidly growing tech sectors, offering a wide range of financial services and products through innovative digital platforms.

An API is a program that lets other programs talk to each other. For example, an API allows a FinTech program to interact with a financial institution's server. APIs are the technological means by which FinTech and financial services communicate with each other. Using APIs, programs can access information from one another and make transactions or make modifications.

Benefits of APIs

Cost-Effective:

APIs help to tailor a client's experience, saving banks money in the long run and helping their customers. Instead of being stuck with a boring, over-simplified platform, banking customers can customize their services exactly to their needs.

Thanks to the use of APIs, banks are able to provide customers with even more services. One example is the integration of bank accounts with software that allows customers to manage their finances in one place.

Data Accessibility:

Before the introduction of PSD2 in 2016, banks could keep their data and information hidden from the public. Keeping the data and information locked away was seen as a good thing, but it made it hard for programs and users to access the valuable data they need. PSD2 makes financial data accessible to third parties.

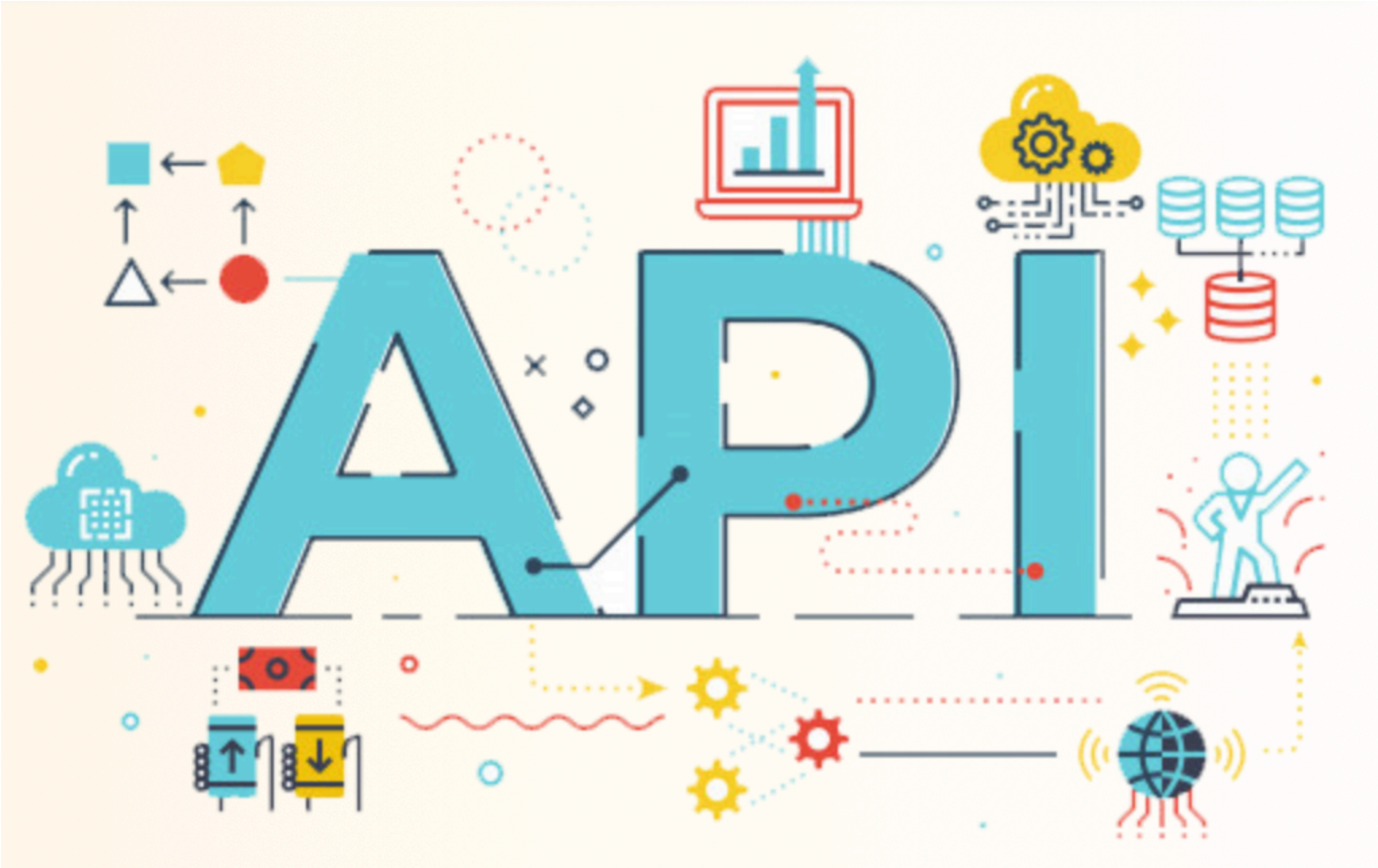
The right to manage or access one's data has always been a core property of the digital age, and it is the foundation of both the GDPR and PSD2. In this new era of intelligent automation, we can now use our mobile phones to control all aspects of our lives.

The new EU regulation will make users even more aware of what is going on with their data. Users will now have the legal right to know how their personal information is used. Before, users had to trust a company not to misuse their data. Now, they can let companies know if they want to continue to use their information.

Growth-led

The number of financial technology APIs has increased dramatically in recent years, helping to provide a wide variety of financial data for use in FinTech applications. The continued growth and development have meant that financial technology is becoming more and more robust. It will continue to develop and grow into the future.

Trading APIs

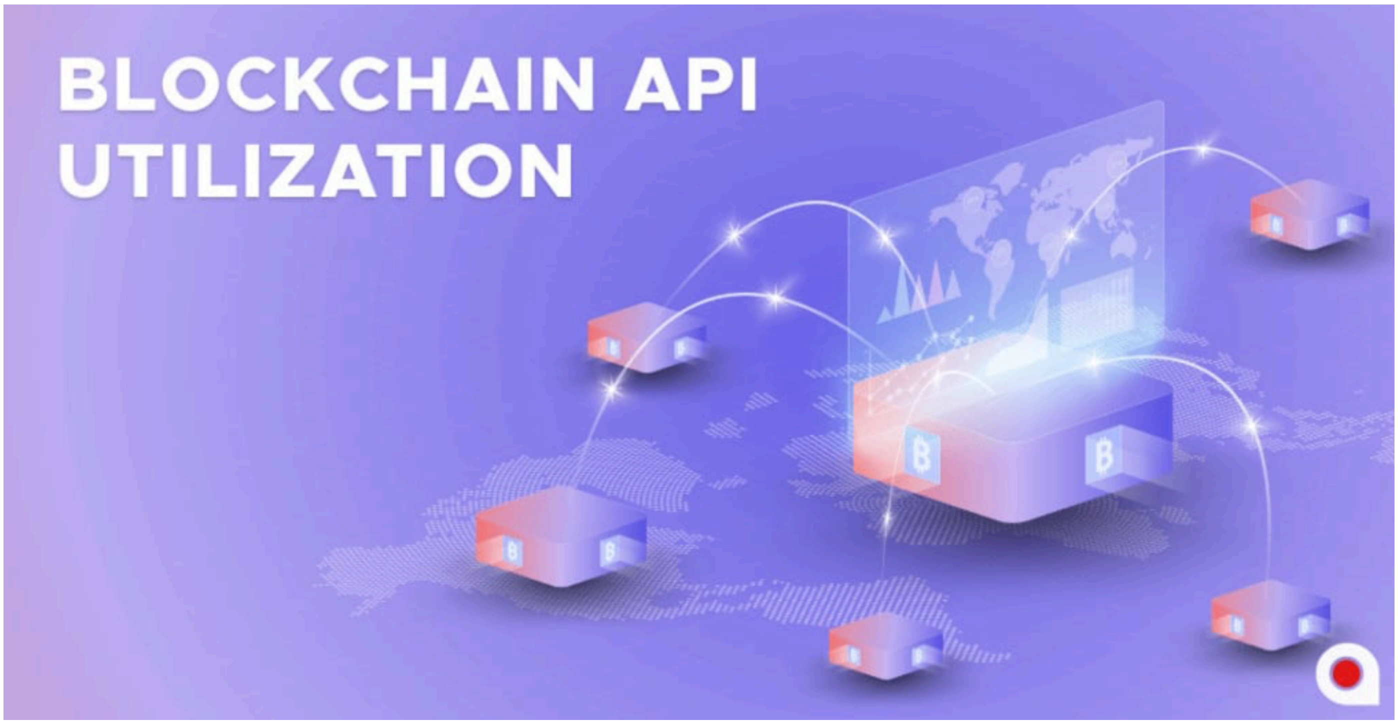


An application programming interface (API) is a software bridge that allows computers to communicate and execute tasks with each other. You can think of it as a language translator for computers. An API links a trader's account with a broker's automated trading system to execute trades quickly and efficiently, and to perform (algo) or programmable trades in certain scenarios. APIs have gained popularity as traders realize the benefits of automated trading tools, which allow them to hedge bets into the future, and abandon traditional manual trades. Whether it's a stock trading API or a bitcoin trading API, the key functions and benefits remain the same.

What Can an API Do?

A cryptocurrency exchange's API acts as a middleman between you and your broker so you can perform various transactions. These may include buying and selling assets, viewing real-time market data, and executing more sophisticated trading strategies. Cryptocurrency exchanges, for instance, use APIs to offer customers the ability to trade cryptocurrency pairs and carry out basic to high-performance trading through premium trading platforms. Experienced day traders can engage in advanced charting, multiple order types, auctions, and block trading, among other functions.

Top APIs for Crypto Traders



Gemini, Binance, Bittrex, Bitfinex, Coinbase, and Kraken, for example, are some of the top crypto exchanges to offer API trading. For algorithmic traders with customized programs, they offer various ways to connect through popular API protocols such as REST, Websocket, and FIX.

Who Can Benefit From API Trading?

Anyone interested in trading can benefit from using APIs. Traders can use APIs to trade stocks, crypto, commodities, and virtually every other asset under the sun. Traders who wish to develop their own trading strategies can also use niche API protocols such as MetaTrade, which targets currency traders, or charting and futures platforms such as AmiBroker or NinjaTrader, respectively. Those who want to develop trading strategies from scratch can use coding software such as Python, C++, or Java.

APIs in Retail and Ecommerce

Close to 80 percent of Americans have purchased at least one item online, the Pew Research Center has found, as e-commerce and mobile devices forever change the retail space.

- Most point-of-sale (POS) systems today have internet connectivity, with APIs helping to connect the POS with internal databases and bank-owned systems. APIs also help POS terminals accept payments from a wide variety of sources, including cash, cards and mobile devices like smart watches.
- Shops—both brick and mortar stores and e-commerce sites—use APIs to keep track of inventory. This technology ensures that customers can see if a desired item is in stock beforehand and that businesses can proactively keep supplies full.
- With e-commerce, a lot can go wrong in the process of getting an item to a customer's front door. APIs help customers and companies track shipments and stay on top of packages.

- APIs also underpin much of what happens inside a physical store, including software that handles employee scheduling and analytics solutions that help determine when to stock seasonal items.

While connectivity demands have changed, the central tenets of SOA (Service Oriented Architecture) have not, that is, the distillation of software into services that are well-defined, reusable, and discoverable. This vision is perhaps even more important given the proliferation of endpoints. The complexity of providing multiple stakeholders customized views of the same underlying data source, whether it be a core banking system or an ERP system, increases exponentially with the number of channels through which that data must be provided. It also reinforces the need for data at the point of consumption to be decoupled and independent from the system of record. This problem lends itself to a service-oriented approach in which application logic is broken down into individual services and then reused across multiple channels. Yet, the heavyweight, top-down implementation approaches previously noted are not a fit for the agility that today’s digital transformation initiatives demand.

API-led connectivity builds on the central tenets of SOA, yet re-imagines its implementation for today’s unique challenges. API-led is an approach that defines methods for connecting and exposing assets. The approach shifts the way IT operates and promotes decentralized access to data and capabilities, while not compromising governance. And the outcome of API-led connectivity is an application network: a network of applications, data, and devices that are ‘pluggable’, providing the agility that the speed of today’s digital transformation demands.

API-led connectivity calls for a distinct connectivity building block that encapsulates three components:

- **Interface**: Presentation of data in a governed and secured form.
- **Orchestration**: Application of logic to that data, such as transformation and enrichment.

- **Connectivity**: Access to source data, whether from physical systems or from external services.

Designed with the consumption of data top of mind, APIs are the instruments that provide both a consumable and controlled means of accessing connectivity. They serve as a contract between the consumer of data and the provider of that data that acts as both a point of demarcation and a point of abstraction, decoupling the two parties and allowing both to work independently of one another (as long as they continue to be bound by the API contract). Finally, APIs also play an important governance role in securing and managing access to that connectivity.

However, the integration application must be more than just an API; the API can only serve as a presentation layer if it sits over a set of orchestration and connectivity flows. This orchestration and connectivity are critical: without it, API-to-API connectivity is simply another means of building out point-to-point integration. These APIs perform specific functions and provide access to non-central data and may be built by either central IT or line of business IT.

APIs vs. API-led connectivity Stripe, an “API as a company” disinter-mediating the payments space, is an archetype of the API economy. At MuleSoft’s CONNECT conference, Stripe’s CEO John Collison was quoted saying, “you don’t slather an API on a product like butter on toast.” Thought of in isolation, the API is only a shim that hides complexities of back-end orchestration and connectivity yet does nothing to address those issues. Connectivity is a multi-faceted problem across data access, orchestration, and presentation, and the right solution must consider this problem holistically rather than in a piecemeal fashion. To only consider APIs is to only solve only one part of the connectivity challenge.

Read how APIs are enabling innovation in retail...

FinTech Use Cases

Though the tech industry is associated with disruptive technology and startups, big businesses and banks are also using the same FinTech services. Here's a quick look at a few FinTech examples and how the industry is using these same technologies to enhance their existing business strategies and disrupt how they do things in the future.

Banking:

Mobile banking has become an important part of the financial services industry. With the spread of neobanks such as GoCardless and Revolut, many banks are offering mobile-friendly banking features. These features attract a diverse customer base, making it easier for consumers to manage their finances.

Neobanks are essentially mobile-optimized banks, offering a variety of banking services on their web and app-only platforms. They operate without the need for physical branch locations or brick-and-mortar offices. From personal checking accounts to money transfers, loans to savings accounts, these banks have it all. Some of the more popular neobanks include Chime, Simple, and Varo.

Cryptocurrency & Blockchain:

The crypto-currency phenomenon is a new kind of financial innovation that will allow us to rethink the way we engage with money, with money transforming into data. Blockchain, the technology upon which cryptocurrency is built, is a new kind of database that can be used to store and share information. Both of these are considered outside the realm of FinTech, but they are increasingly working together as complementary solutions for consumers.

Investment & Savings:

FinTech has caused a revolution in investing. The barriers to investing are falling as more and more easy-to-use apps are made available to consumers. With hundreds of apps on the market, this booming industry is making it easier than ever for consumers to invest their money. One of the most popular and best-known apps is Robinhood, which makes it incredibly easy for anyone to invest their money and learn about the markets.

Trading:

The evolution of financial technology has seen the rise of Artificial Intelligence technologies that can extract financial insights from massive datasets. By using advanced natural language processing, these technologies allow traders and investors to gain meaningful insights in a matter of seconds.

Seven Common Myths About APIs

"APIs are a new technology"

APIs as Application Programming Interfaces have been around since the advent of software, but the first time the term was officially coined was in

1968. But from the 1990's and the era of Services and SOA, the service interface concept has been tightly coupled with vendors and software products (eg. ESB, Webmethods, SOAP/XML Webservices, CORBA). As this set of technology did not deliver its promises, in the 2000's, the industry pushed the word “API” as the new concept to enable the transition to a new set of technologies and products and detach the service interface concept from their out of fashioned products.

APIs are not binded to any technology. Would you say that HMI (Human Machine Interface) is a technology or is a design practice that involves technologies that can change over time? APIs are these Software to Software Interfaces.

“APIs are a technical topic”

Originally yes, but in a world where IT capabilities are a competitive advantage, APIs are also a business topic. Especially when you consider Conway’s law, that states that organizations who design communication systems are condemned to reproduce their organization's structure inside their communication systems. APIs are a way to expose capabilities as products and liberate interactions in the organizations, making them discoverable, autonomously integrable by others and managed like products. In that sense, APIs are an IT term, with business implications and must be considered now not only like a technical topic. The APIs-as-product concept reinforces the idea that APIs are not just a technical topic.

“APIs must be handled by the IT department”

Because of their ability to re-align business with IT, exposing capabilities as products, IT department is not designed to handle alone all the aspects of API-led transformation. Most of the time, when IT is the only one involved in APIs, APIs are designed more towards integration and technical interoperability between internal services instead of focusing on exposing capabilities towards business departments. This is why most of company-wide API-led transformations involved often an API-Center of Enablement group, that mixes IT departments stakeholders but also business stakeholders, and sometimes Sales, compliance and HR!

"APIs must expose the data or the service as it is in the system"

The main interest of designing APIs is the ability to use the interface representation to expose only what needs to be exposed, and in the way that will help and inspire future implementers to understand the underlying capabilities in his context.This is why we often consider APIs as much exposing interfaces ads hiding interfaces.

Your interface is not your data model or object model. A restaurant menu is not the floor plan of the kitchen and is not the list of ingredients in the fridge! It exposes what can be ordered and hide what the kitchen can probably do but that the Chef don't want you to know.

"There is a 1to1 relationship between APIs and services"

When most of the time it is designed that way, there is not a necessary a 1 to 1 relationship between services and APIs. 1 APIs can be the interface to access one or multiple service capabilities and 1 service can have multiple APIs depending on its interactions with others. .Example : 1 API for exposing a Banking scoring capability that call behind the scene 3 different services for current scoring, probability of default in the next 3 months and country risk. It is like a restaurant that would provide 1 menu with food and drinks to customers to make things simple to order, but behind the scene would have an independent kitchen and a bar, that have 2 different P&L. 1 interface, 2 independent services.

On the other side, a Hotel database that expose 1 REST/JSON API to other travel platforms which work with this set of technologies, and expose 1 SOAP/XML API for the Airline ticketing industry that still works in majority with this set of technology. It is like a restaurant that for the same kitchen and food production capabilities design 1 menu for adults and 1 menu for kids. 2 interfaces, 1 service.

So when simplicity or business needs requires it, you can overcome the 1to1 relationship between APIs and Services.

“API Management is about API gateways and security”

API management is the practice to align API enablement and consumption with business priorities, inside or outside the organization, while securing and monitoring traffic and threats. It involves API gateways but also Analytics, Traffic Monitoring, User role management, Developer portals, and more and more features on the API lifecycle management like API design, API documentation, API testing and API Versioning. The end-goal of API management is to align APIs with Business KPIs.

“APIs need a business model”

Not all APIs are made to be exposed outside the organization, and when they are, lots of people consider that they must be monetized and thought with a dedicated business model in mind. Unless your main company product is an API, for organizations which have already a business model, you should not think in terms of what is the best business model for your APIs, but what are the best APIs for my business model. For example, Insurers may want to open API for free to create an ecosystem of applications for their customer and become a platform, to at the end create more customer acquisition and retention on sold policies, just sticking and scaling their existing business model, and not inventing new ones for their APIs.

Other myths that have been spread about APIs are as follows:

- “Micro-services don’t need APIs”
- “Designing an API is to write its Open API specification”
- “Documenting an API is to provide a good API reference”
- “Developers portals are for external developers only”
- “Developer portals are the only way to expose APIs for discoverability”
- " API keys and OAuth are authentications method for APIs"

Algorithmic Trading Tech Stack

Objectives:

- Students will gain an understanding of what to look for in an algorithmic trading software.
- Students will be able to learn which is better: build or buy.
- Students will gain an understanding of Calypso markets and how they relate to algorithmic trading.

While using algorithmic trading, traders trust their hard-earned money to their trading software. For that reason, the correct piece of computer software is essential to ensure effective and accurate execution of trade orders. On the other hand, faulty software—or one without the required features—may lead to huge losses, especially in the lightning-fast world of algorithmic trading. A Quick Primer on Algorithmic Trading An algorithm is defined as a specific set of step-by-step instructions to complete a particular task. Whether it is the simple-yet-addictive computer game like Pac-Man or a spreadsheet that offers a huge number of functions, each program follows a specific set of instructions based on an underlying algorithm.

- Picking the correct software is essential in developing an algorithmic trading system.
- A trading algorithm is a step-by-step set of instructions that will guide buy and sell orders.
- Faulty software can result in hefty losses when trading financial markets
- There are two ways to access algorithmic trading software: buy it or build it.
- Ready-made algorithmic trading software usually offers free trial versions with limited functionality.

Algorithmic trading is the process of using a computer program that follows a defined set of instructions for placing a trade order. The aim of the algorithmic trading program is to dynamically identify profitable opportunities and place the trades in order to generate profits at a speed and frequency that is impossible to match by a human trader. Given the advantages of higher accuracy and lightning-fast execution speed, trading activities based on computer algorithms have gained tremendous popularity.

Who Uses Algorithmic Trading Software?

Algorithmic trading is dominated by large trading firms, such as hedge funds, investment banks, and proprietary trading firms. Given the abundant resource availability due to their large size, such firms usually build their own proprietary trading software, including large trading systems with dedicated data centers and support staff.

At an individual level, experienced proprietary traders and quants use algorithmic trading. Proprietary traders, who are less tech-savvy, may purchase ready-made trading software for their algorithmic trading needs. The software is either offered by their brokers or purchased from third-party providers. Quants generally have a solid knowledge of both trading and computer programming, and they develop trading software on their own.

Algorithmic Trading Software: Build or Buy?

There are two ways to access algorithmic trading software: build or buy.

Purchasing ready-made software offers quick and timely access while building your own allows full flexibility to customize it to your needs. The automated trading software is often costly to purchase and may be full of loopholes, which, if ignored, may lead to losses. The high cost of the software may also eat into the realistic profit potential from your algorithmic trading venture. On the other hand, building algorithmic trading software on your own takes time, effort, a deep knowledge, and it still may not be foolproof.

The Key Features of Algorithmic Trading Software

The risk involved in automatic trading is high, which can lead to large losses. Regardless of whether you decide to buy or build, it is important to be familiar with the basic features needed.

Availability of Market and Company Data

All trading algorithms are designed to act on real-time market data and price quotes. A few programs are also customized to account for company fundamentals data like earnings and P/E ratios. Any algorithmic trading software should have a real-time market data feed, as well as a company data feed. It should be available as a build-in into the system or should have a provision to easily integrate from alternate sources.

Connectivity to Various Markets

Traders looking to work across multiple markets should note that each exchange might provide its data feed in a different format, like TCP/IP, Multicast, or FIX. Your software should be able to accept feeds of different formats. Another option is to go with third-party data vendors like Bloomberg and Reuters, which aggregate market data from different exchanges and provide it in a uniform format to end clients. The algorithmic trading software should be able to process these aggregated feeds as needed.

Latency

This is the most important factor for algorithm trading. Latency is the time-delay introduced in the movement of data points from one application to the other. Consider the following sequence of events. It takes 0.2 seconds for a price quote to come from the exchange to your software vendor's data center (DC), 0.3 seconds from the data center to reach your trading screen, 0.1 seconds for your trading software to process this received quote, 0.3 seconds for it to analyze and place a trade, 0.2 seconds for your trade order to reach your broker, 0.3 seconds for your broker to route your order to the exchange.

Total time elapsed = 0.2 + 0.3 + 0.1 + 0.3 + 0.2 + 0.3 = Total 1.4 seconds.

In today's dynamic trading world, the original price quote would have changed multiple times within this 1.4 second period. Any delay could make or break your algorithmic trading venture. One needs to keep this latency to the lowest possible level to ensure that you get the most up-to-date and accurate information without a time gap.

Latency has been reduced to microseconds, and every attempt should be made to keep it as low as possible in the trading system. A few measures to improve latency include having direct connectivity to the exchange to get data faster by eliminating the vendor in between; improving the trading algorithm so that it takes less than 0.1+0.3 = 0.4 seconds for analysis and decision-making; or by eliminating the broker and directly sending trades to the exchange to save 0.2 seconds.

Configurability and Customization

Most algorithmic trading software offers standard built-in trade algorithms, such as those based on a crossover of the 50-day moving average (MA) with the 200-day MA. A trader may like to experiment by switching to the 20-day MA with the 100-day MA. Unless the software offers such customization of parameters, the trader may be constrained by the built-ins fixed functionality. Whether buying or building, the trading software should have a high degree of customization and configurability.

Functionality to Write Custom Programs

Matlab, Python, C++, JAVA, and Perl are the common programming languages used to write trading software. Most trading software sold by third-party vendors offers the ability to write your own custom programs within it. This allows a trader to experiment and try any trading concept. Software that offers coding in the programming language of your choice is obviously preferred.

Backtesting Feature on Historical Data

Backtesting simulation involves testing a trading strategy on historical data. It assesses the strategy's practicality and profitability on past data, certifying it for success (or failure or any needed changes). This mandatory feature also needs to be accompanied by the availability of historical data on which the backtesting can be performed.

Integration With Trading Interface

Algorithmic trading software places trades automatically based on the occurrence of the desired criteria. The software should have the necessary connectivity to the broker(s) network for placing the trade or a direct connectivity to the exchange to send the trade orders.

Plug-n-Play Integration

A trader may be simultaneously using a Bloomberg terminal for price analysis, a broker's terminal for placing trades, and a Matlab program for trend analysis. Depending upon individual needs, the algorithmic trading software should have easy plug-and-play integration and available APIs across such commonly used trading tools. This ensures scalability, as well as integration.

Platform-Independent Programming

A few programming languages need dedicated platforms. For example, certain versions of C++ may run only on select operating systems, while Perl may run across all operating systems. While building or buying trading software, preference should be given to trading software that is platform-independent and supports platform-independent languages. You never know how your trading will evolve a few months down the line.

A common saying goes, "Even a monkey can click a button to place a trade." Dependency on computers should not be blind. It is the trader who should understand what is going on under the hood. While buying trading software, one should ask for (and take the time to go through) the detailed documentation that shows the underlying logic of a particular algorithmic trading software. Avoid any trading software that is a complete black box, and that claims to be a secret moneymaking machine.

While building software, be realistic about what you are implementing and be clear about the scenarios where it can fail. Thoroughly backtest the approach before using real money.

Where to Begin?

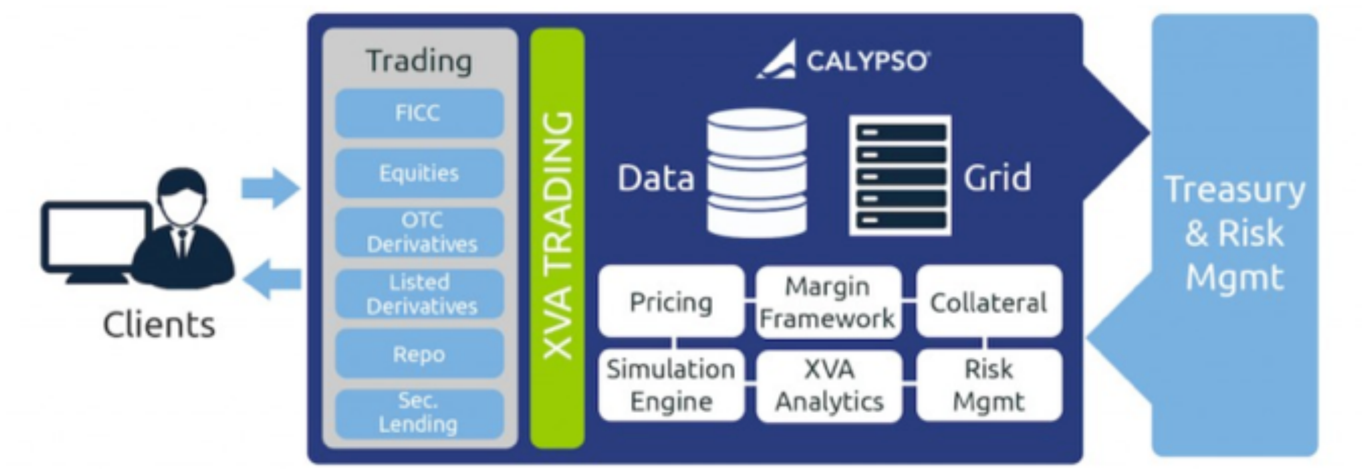
Ready-made algorithmic trading software usually offers free limited functionality trial versions or limited trial periods with full functionality. Explore them in full during these trials before buying anything. Do not forget to go through the available documentation in detail.

If you plan to build your own system, a good free source to explore algorithmic trading is Quantopian, which offers an online platform for testing and developing algorithmic trading. Individuals can try and customize any existing algorithm or write a completely new one. The platform also offers built-in algorithmic trading software to be tested against market data.

The Bottom Line

Algorithmic trading software is costly to purchase and difficult to build on your own. Purchasing ready-made software offers quick and timely access, and building your own allows full flexibility to customize it to your needs. Before venturing into algorithmic trading with real money, however, you must fully understand the core functionality of the trading software. Failure to do so may result in big losses.

Calypso Markets



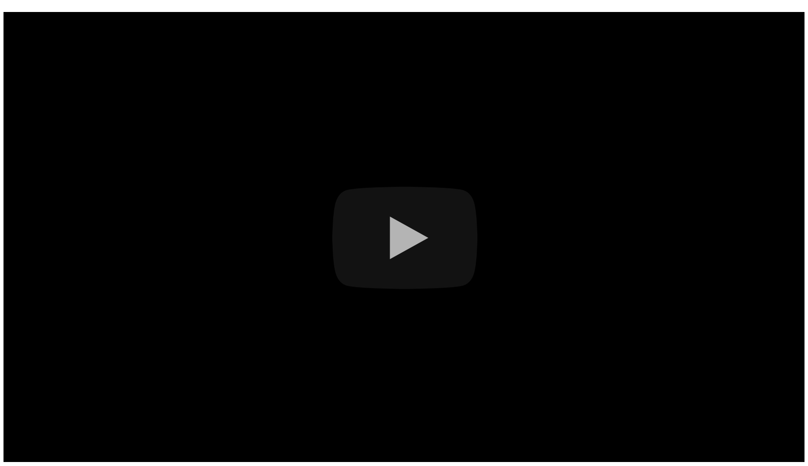
Calypso Technology, Inc. is a cloud-enabled provider of cross-asset front-to-back solutions for financial markets with over 40,000 users in 60+ countries. Its award-winning software improves reliability, adaptability, and scalability across several verticals, including capital markets, investment management, central banking, clearing, treasury, liquidity, and collateral. Calypso is leveraging innovative cloud microservices and blockchain distributed ledger technology (DLT) based solutions to reduce trading costs and improve time to value.

With 20 years of experience delivering cross-asset solutions for trading, processing, risk management and accounting, we are able to focus our significant resources on customer problems, bringing simplicity to the most complex business and technology issues. The constant pressures for better allocation of capital and improved risk management, matched by an ever changing regulatory landscape in the financial markets demand technology solutions that are reliable, adaptable and scalable. In response Calypso provides customers with a single platform designed from the outset to enable consolidation innovation and growth.

The result is compelling. Faster time to new markets, enterprise risk reduction and lower technology costs drive immediate improvements to our customers' bottom line.

Calypso software and Cloud services support trading, risk management, collateral, processing, accounting and compliance needs in a uniquely integrated platform, bringing simplicity and cost efficiency to address today's business and regulatory imperatives. The firm is consistently granted the most prestigious product and technology awards in the industry.

The facts speak for themselves. Calypso is used by over 40,000 market professionals in over 60 countries. Representing more than 200 financial institutions, our customers operate in a diverse range of developed and emerging markets across Asia, Americas, Europe, Middle East and Africa. Calypso has over 800 staff in over 23 global offices, with headquarters in San Francisco, California.



For more information regarding algorithmic trading platforms click here.

Algorithmic Trading Models using Python

Objectives:

- Students will be able to. describe how Python is useful in creating and executing algorithmic trading
- Students will be able to implement basic algorithmic trading functions using Python

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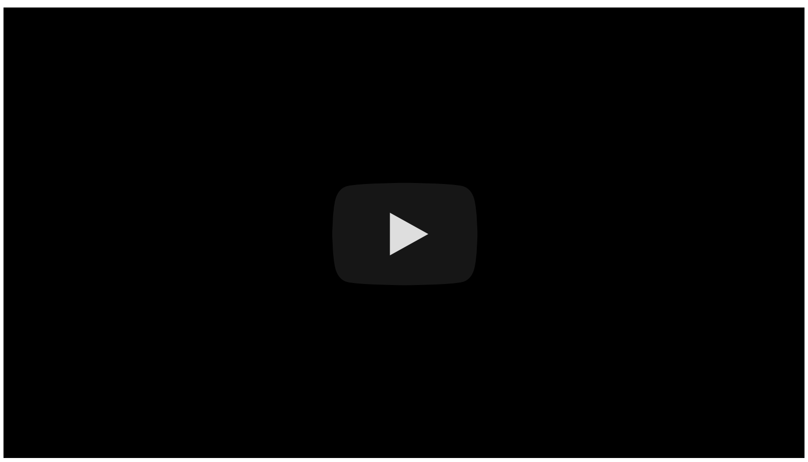
Introduction



Got Python? If you’re serious about financial markets and algorithmic trading, then you’re going to need it. Python is a computer programming language that is used by institutions and investors alike every day for a range of purposes, including quantitative research, i.e. data exploration and analysis, and for prototyping, testing, and executing trading algorithms. In the recent past, however, only the big institutional players had the money and tech know-how to harness the benefits

of algorithmic trading, but the times they are a-changin'. Before we dig deeper into the finer points of Python and how to get started in algorithmic trading with Trality, let's take a brief trip back to the future.

Getting Started with Python and Algorithmic Trading

With Trality's industry-leading technology, anyone can take advantage of Python in order to build a crypto trading bot and gain a leg up in algorithmic trading. Our world-beating Code Editor is the world's first browser-based Python Bot Code Editor, which comes with a state-of-the-art Python API, numerous packages, a debugger and end-to-end encryption. We offer the highest levels of flexibility and sophistication available in private trading. In fact, it's the core of what we do at Trality. If you're already proficient in Python, then take a look at the informative video that Trality co-founder and CEO Moritz Putzhammer has put together about coding your first (or next) bot. Follow the step-by-step guide, which covers topics including choosing a bot template, the four basic steps in algorithm creation, Trality's all new Position Management System (tracks key metrics automatically), backtesting, fine-tuning your strategy, adding exchanges, and virtual/live trading. We also urge you to take advantage of Trality Documentation, a really useful tool that provides a detailed introduction to our Code Editor (e.g. core concepts, APIs, and our Cook Book).

What makes a good algorithmic trader?

Sprint, swim, cycle—algorithmic trading is a lot like being a triathlete. Now I know what you're thinking: not another one of those inspirational sports analogies... Just like triathletes, though, traders must master three essential skills in order to succeed: math, finance and coding. You can be brilliant at math and know coding inside-out, but if you don't know much about finance then you're going to have difficulty making it to the finish line. You need to have creative ideas about how to trade, you need to be able to translate those ideas into mathematical models, and finally implement them in code. But it's more than just mastering technical skills. Anyone can learn to swim. Or become good at running. Or be a whiz on a bike. Those are the things that will get you past the qualifying stage and into the race. But to really outperform others or exceed what you thought was possible for yourself, you've got to love the feel of the water and the ground beneath your feet, and that metal frame, with its gears, pedals and wheels, needs to become an extension of your body. At Trality, we can equip you with world-class, state-of-the-art tools to put you in the best position possible when it comes to the big race. The rest is up to you.

Learn How to Crunch Financial Data

Data analysis is a crucial part of finance. Besides learning to handle dataframes using Pandas, there are a few specific topics that you should pay attention to while dealing with trading data.

How to exploring data using Pandas

One of the most important packages in the Python data science stack is undoubtedly Pandas. You can accomplish almost all major tasks using the functions defined in the package. Focus on creating dataframes, filtering (loc, iloc, query), descriptive statistics (summary), join/merge, grouping, and subsetting.

How to deal with time-series data

Trading data is all about time-series analysis. You should learn to resample or reindex the data to change the frequency of the data, from minutes to hours or from the end of day OHLC data to end of week data. For example, you can convert 1-minute time series into 3-minute time series data using the resample function:

```
df_3min = df_1min.resample('3Min', label='left').agg({'OPEN':
'first', 'HIGH': 'max', 'LOW': 'min', 'CLOSE': 'last'})
```

How to Write Fundamental Trading Algorithms

A career in quantitative finance requires a solid understanding of statistical hypothesis testing and mathematics. A good grip over concepts like multivariate calculus, linear algebra, probability theory will help you lay a good foundation for designing and writing algorithms.

You can start by calculating moving averages on stock pricing data, writing simple algorithmic strategies like moving average crossover or mean reversion strategy and learning about relative strength trading.

After taking this small yet significant leap of practicing and understanding how basic statistical algorithms work, you can look into the more sophisticated areas of machine learning techniques. These require a deeper understanding of statistics and mathematics.

Here are two books you can start with:

- Quantitative Trading: How to build your own Algorithmic Trading Business —By Dr. Ernest Chan
- Book on Algorithmic Trading and DMA — By Barry Johnson

Learn About Backtesting

Once you are done coding your trading strategy, you can't simply put it to the test in the live market with actual capital, right? The next step is to expose this strategy to a stream of historical trading data, which would generate trading signals. The carried out trades would then accrue an associated profit or loss (P&L) and the accumulation of all the trades would give you the total P&L. This is called backtesting.

Backtesting requires you to be well-versed in many areas, like mathematics, statistics, software engineering, and market microstructure. Here are some concepts you should learn to get a decent understanding of backtesting:

- You can start by understanding technical indicators. Explore the Python package called TA_Lib to use these indicators.
- Employ momentum indicators like parabolic SAR, and try to calculate the transaction cost and slippage.
- Learn to plot cumulative strategy returns and study the overall performance of the strategy.
- A very important concept that affects the performance of the backtest is bias. You should learn about optimization bias, look-ahead bias, psychological tolerance, and survivorship bias.

Performance Metrics—How to Evaluate Trading Strategies

It's important for you to be able to explain your strategy concisely. If you don't understand your strategy, chances are on any external modification of regulation or regime shift, your strategy will start behaving abnormally.

Once you understand the strategy confidently, the following performance metrics can help you learn how good or bad the strategy actually is:

Sharpe Ratio—heuristically characterizes the risk/reward ratio of the strategy. It quantifies the return you can accrue for the level of volatility undergone by the equity curve.

- Volatility—quantifies the "risk" related to the strategy. The Sharpe ratio also embodies this characteristic. Higher volatility of an underlying asset often leads to higher risk in the equity curve and that results in smaller Sharpe ratios. Maximum Drawdown—the largest overall peak-to-trough percentage drop on the equity curve of the strategy.

- Maximum drawdowns are often studied in conjunction with momentum strategies as they suffer from them. Learn to calculate it using the numpy library.
- Capacity/Liquidity—determines the scalability of the strategy to further capital. Many funds and investment management firms suffer from these capacity issues when strategies increase in capital allocation.
- CAGR—measures the average rate of a strategy's growth over a period of time. It is calculated by the formula: (cumulative strategy returns)^(252/number of trading days)

Having issues? Report here.

Week 5 Quiz Reviews

Objectives:

- Students will review what they learned by going to *Trading, Markets & Algorithms*
- Students will review quizzes from Week 5 (Trading, Markets & Algorithms).

Trading & Markets Deep Dive Quiz Review

Which is not a consideration in regards to trend following?

A. Asset price difference between exchanges

B. Money management

C. Diversification

D. Risk control

A strategy that is bottom-up, beta-neutral in approach and uses statistical/econometric techniques to provide signals for execution is ____________________.

A. Diversification

B. Designated Market Maker

C. StatArb

Mean Reversion

The average size of a bond trade tends to be substantially greater than for an equity trade.

A. True

B. False

What type of investment is a financial asset that does not fall into one of the conventional investment categories?

A. Annuities

B. Currencies

C. Alternative

D. Bonds

Traders who believe that current or past price action in the market is the most reliable indicator of future price action are __________________.

A. Functional

B. Technical

C. Sentiment

D. None of the above

What type of market is where financial instruments are traded for immediate delivery?

A. Money Market

B. Spot Market

C. Futures

D. CFD Market

Algorithmic Trading Basics Quiz Review

______________ can be defined as the level of correlation in a forecast with returns realized.

A. Return

B. Breadth

C. Diversification

D. Information Coefficient

Which ratio is used to help measure portfolio returns beyond the returns of a benchmark?

A. Standard Deviation

B. Treynor Ratio

C. Sharpe Ratio

D. Information Ratio

Automated trading, black-box trading and algo-trading are also called what ______________.

A. API Trading

B. Asset Trading

C. Diversified Trading

D. Algorithmic Trading

Discretionary trading removes all human emotions from the process of trading.

A. True

B. False

_________________ of a portfolio measures how much the investment returns deviate from the mean of the probability of investments.

A. Treynor Measure

B. Sharpe Ratio

C. Standard Deviation

D. Jensen Ratio

Trading APIs Interactions Quiz Review

Who can benefit from API Trading?

A. Investors

B. Students

C. Traders

D. Anyone interested in trading

Interface, Orchestration and Connectivity are three components of what?

A. APIs

B. Algorithmic databases

C. API-led connectivity

D. Point of Sale systems

Before the introduction of ________ in 2016, banks could keep their data and information hidden from the public.

A. PS2

B. API

C. PSD2

D. GDPR

APIs must expose the data or the service as it is in the system.

A. True

B. False

The evolution of financial technology has seen the rise of ___________ ______________ technologies that can extract financial insights from massive datasets.

A. Mixed Reality

B. FinTech Banking

C. Diversified Transaction

D. Artificial Intelligence

Algorithmic Trading Tech Stack & Models in Python Quiz Review

Which is not a key feature of algorithmic trading software?

A. Connectivity to various markets

B. Platform-dependent programming

C. Functionality to write custom programs

D. Configurability and Customization

Backtesting simulation involves testing a trading strategy on _____________data.

A. Current

B. Latency

C. Historical

D. None of the above

In the lesson it was discussed if you were planning to build your own system, a good service to explore algorithmic trading is ____________.

A. CloudQuant

B. Quantra

C. Algovest

D. Quantopian

‹ PREVIOUS (/M/329/10315/70525)
NEXT › (/M/329/10315/SURV