大數據分析
(Big Data Analysis)

AI 機器人理財顧問
(Artificial Intelligence for Robo-Advisors)

1091BDA07
MBA, IM, NTPU (M5127) (Fall 2020)
Wed 7, 8, 9 (15:10-18:00) (B8F40)

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副教授
Institute of Information Management, National Taipei University

https://web.ntpu.edu.tw/~myday
2020-12-23
<table>
<thead>
<tr>
<th>週次 (Week)</th>
<th>日期 (Date)</th>
<th>內容 (Subject/Topics)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>2020/09/16</td>
<td>大數據分析介紹 (Introduction to Big Data Analysis)</td>
</tr>
<tr>
<td>2</td>
<td>2020/09/23</td>
<td>AI人工智慧與大數據分析 (AI and Big Data Analysis)</td>
</tr>
<tr>
<td>3</td>
<td>2020/09/30</td>
<td>Python 大數據分析基礎 (Foundations of Big Data Analysis in Python)</td>
</tr>
<tr>
<td>4</td>
<td>2020/10/07</td>
<td>數位沙盒第一堂課：數位沙盒服務平台簡介 (Digital Sandbox Lesson 1: Introduction to FintechSpace Digital Sandbox)</td>
</tr>
<tr>
<td>5</td>
<td>2020/10/14</td>
<td>數位沙盒第二堂課：工程師操作說明與實作教學 (Digital Sandbox Lesson 2: Hands-on Practices)</td>
</tr>
<tr>
<td>6</td>
<td>2020/10/21</td>
<td>Python Pandas 大數據量化分析 (Quantitative Big Data Analysis with Pandas in Python)</td>
</tr>
</tbody>
</table>
週次 (Week) 日期 (Date) 內容 (Subject/Topics)
7 2020/10/28 Python Scikit-Learn 機器學習 I
(Machine Learning with Scikit-Learn in Python I)
8 2020/11/04 數位沙盒第三堂課：學生小組討論實作與成果發表
(Digital Sandbox Lesson 3: Learning Teams Hands-on Project Discussion and Project Presentation)
9 2020/11/11 期中考告 (Midterm Project Report)
10 2020/11/18 Python Scikit-Learn 機器學習 II
(Machine Learning with Scikit-Learn in Python II)
11 2020/11/25 TensorFlow 深度學習金融大數據分析 I
(Deep Learning for Finance Big Data Analysis with TensorFlow I)
12 2020/12/02 大數據分析個案研究
(Case Study on Big Data Analysis)
課程大綱 (Syllabus)

週次 (Week)  日期 (Date)  內容 (Subject/Topics)
13  2020/12/09  TensorFlow 深度學習金融大數據分析 Ⅱ  
        (Deep Learning for Finance Big Data Analysis with TensorFlow Ⅱ)
14  2020/12/16  TensorFlow 深度學習金融大數據分析 Ⅲ  
        (Deep Learning for Finance Big Data Analysis with TensorFlow Ⅲ)
15  2020/12/23  AI 機器人理財顧問  
        (Artificial Intelligence for Robo-Advisors)
16  2020/12/30  金融科技智慧型交談機器人   
        (Conversational Commerce and Intelligent Chatbots for Fintech)
17  2021/01/06  期末報告 I (Final Project Report I)
18  2021/01/13  期末報告 II (Final Project Report I)
Artificial Intelligence for Robo-Advisors
Robotic Process Automation (RPA)
AI
Robo-Advisor
in
FinTech
AIWISFIN
AI Conversational Robo-Advisor
(人工智慧對話式理財機器人)
First Place, InnoServe Awards 2018

https://www.youtube.com/watch?v=sEhmyoTXmGk
2018 The 23\textsuperscript{th} International ICT Innovative Services Awards (InnoServe Awards 2018)

- Annual ICT application competition held for university and college students
- The largest and the most significant contest in Taiwan.
- More than ten thousand teachers and students from over one hundred universities and colleges have participated in the Contest.

https://innoserve.tca.org.tw/award.aspx
2018 International ICT Innovative Services Awards (InnoServe Awards 2018)
(2018第23屆大專校院資訊應用服務創新競賽)

https://innoserve.tca.org.tw/award.aspx
FinTech Innovation: From Robo-Advisors to Goal Based Investing and Gamification,
Paolo Sironi, Wiley, 2016


Source: https://www.amazon.com/Essentials-Investments-Zvi-Bodie-Professor/dp/1260013928
Artificial Intelligence (AI)
Investment Analysis
Robo-Advisors
Artificial Intelligence and Deep Learning for Fintech
From Algorithmic Trading to Personal Finance Bots: 41 Startups Bringing AI to Fintech

Source: https://www.cbinsights.com/blog/artificial-intelligence-fintech-market-map-company-list/
From Algorithmic Trading To Personal Finance Bots: 41 Startups Bringing AI To Fintech

AI in Fintech

41 Startups Bringing Artificial Intelligence To Fintech

Source: https://www.cbinsights.com/blog/artificial-intelligence-fintech-market-map-company-list/
Artificial Intelligence (AI) in Fintech

General Purpose/Predictive Analytics
- AYASDI
- Digital Reasoning
- context relevant
- H2O
- KENSHO
- cortical.io
- Numenta
- turi
- DataRobot
- Nervana Systems

Market Research & Sentiment Analysis
- indicio
- acuity
- Lucena Quantitative Analytics
- NUMERAI
- Dataminr

Search Engine
- alphasense

Source: https://www.cbinsights.com/blog/artificial-intelligence-fintech-market-map-company-list/
Artificial Intelligence (AI) in Fintech

Quantitative Trading
- Sentient Technologies
- Clone Algo
- Alpaca
- Walnut Algorithms

AI Assistants/Bots
- KASIST
- TRIM
- Penny
- Insurify SURE.

Credit Scoring
- TypeScore
- Aire
- Creditvidya
- Zest Finance
- ADF
- Applied Data Finance
- Wecash
- Cream Finance

Blockchain
- Skry
- Euclid

Debt Collection
- TrueAccord

Fraud Detection
- Feedzai
- Biocatch

Personal Banking
- Personetics

Source: https://www.cbinsights.com/blog/artificial-intelligence-fintech-market-map-company-list/
Evolution of Decision Support, Business Intelligence, and Analytics

The timeline in Figure 1.8 shows the terminology used to describe analytics since the 1970s. During the 1970s, the primary focus of information systems support for decision making focused on providing structured, periodic reports that a manager could use for decision making (or ignore them). Businesses began to create routine reports to inform decision makers (managers) about what had happened in the previous period (e.g., day, week, month, quarter). Although it was useful to know what had happened in the past, managers needed more than this: They needed a variety of reports at different levels of granularity to better understand and address changing needs and challenges of the business. These were usually called management information systems (MIS). In the early 1970s, Scott-Morton first articulated the major concepts of DSS. He defined DSSs as “interactive computer-based systems, which help decision makers utilize data and models to solve unstructured problems” (Gorry and Scott-Morton, 1971).

The following is another classic DSS definition, provided by Keen and Scott-Morton (1978):

Decision support systems couple the intellectual resources of individuals with the capabilities of the computer to improve the quality of decisions. It is a computer-based support system for management decision makers who deal with semistructured problems.

Note that the term decision support system, like management information system and several other terms in the field of IT, is a content-free expression (i.e., it means different things to different people). Therefore, there is no universally accepted definition of DSS.

During the early days of analytics, data was often obtained from the domain experts using manual processes (i.e., interviews and surveys) to build mathematical or knowledge-based models to solve constrained optimization problems. The idea was to do the best with limited resources. Such decision support models were typically called operations research (OR). The problems that were too complex to solve optimally (using linear or nonlinear mathematical programming techniques) were tackled using heuristic methods such as simulation models. (We will introduce these as prescriptive analytics later in this chapter and in a bit more detail in Chapter 6.)

In the late 1970s and early 1980s, in addition to the mature OR models that were being used in many industries and government systems, a new and exciting line of models had emerged: rule-based expert systems. These systems promised to capture experts’ knowledge in a format that computers could process (via a collection of if–then–else rules or heuristics) so that these could be used for consultation much the same way that one...
Artificial Intelligence (A.I.) Timeline

1950
TURING TEST
Computer scientist Alan Turing proposes a test for machine intelligence. If a machine can trick humans into thinking it is human, then it has intelligence.

1955
A.I. BORN
Term “artificial intelligence” is coined by computer scientist John McCarthy to describe “the science and engineering of making intelligent machines.”

1961
UNIMATE
First industrial robot, Unimate, goes to work at GM replacing humans on the assembly line.

1964
ELIZA
Pioneering chatbot developed by Joseph Weizenbaum at MIT holds conversations with humans.

1966
SHAKY
The ‘first electronic person’ from Stanford, Shaky is a general-purpose mobile robot that reasons about its own actions.

1967
A.I. WINTER
Many false starts and dead-ends leave A.I. out in the cold.

1997
DEEP BLUE
Deep Blue, a chess-playing computer from IBM defeats world chess champion Garry Kasparov.

1998
KISMET
Cynthia Breazeal at MIT introduces Kismet, an emotionally intelligent robot insofar as it detects and responds to people’s feelings.

1999
AIBO
Sony launches first consumer robot pet dog AIBO (AIBO) with skills and personality that develop over time.

2002
ROOMBA
First mass produced autonomous robotic vacuum cleaner from iRobot learns to navigate and clean homes.

2011
SIRI
Apple integrates Siri, an intelligent virtual assistant with a voice interface, into the iPhone 4S.

2011
WATSON
IBM’s question answering computer Watson wins first place on popular $1M prize television quiz show Jeopardy.

2014
EUGENE
Eugene Goostman, a chatbot passes the Turing Test with a third of judges believing Eugene is human.

2014
ALEXA
Amazon launches Alexa, an intelligent virtual assistant with a voice interface that completes shopping tasks.

2016
TAY
Microsoft’s chatbot Tay goes rogue on social media making inflammatory and offensive racist comments.

2017
ALPHAGO
Google’s A.I. AlphaGo beats world champion Ke Jie in the complex board game of Go, notable for its vast number (2^192) of possible positions.

Artificial intelligence (AI) is not new. The term was coined in 1956 by John McCarthy, a Stanford computer science professor who organized an academic conference on the topic at Dartmouth College in the summer of that year. The field of AI has gone through a series of boom-bust cycles since then, characterized by technological breakthroughs that stirred activity and excitement about the topic, followed by subsequent periods of disillusionment and disinterest known as 'AI Winters' as technical limitations were discovered. As you can see in figure 1, today we are once again in an 'AI Spring'.

Artificial intelligence can be defined as human intelligence exhibited by machines; systems that approximate, mimic, replicate, automate, and eventually improve on human thinking. Throughout the past half-century a few key components of AI were established as essential: the ability to perceive, understand, learn, problem solve, and reason. Countless working definitions of AI have been proposed over the years but the unifying thread in all of them is that computers with the right software can be used to solve the kind of problems that humans solve, interact with humans and the world as humans do, and create ideas like humans. In other words, while the mechanisms that give rise to AI are 'artificial', the intelligence to which AI is intended to approximate is indistinguishable from human intelligence. In the early days of the science, processing inputs from the outside world required extensive programming, which limited early AI systems to a very narrow set of inputs and conditions. However since then, computer science has worked to advance the capability of AI-enabled computing systems.

Board games have long been a proving ground for AI research, as they typically involve a finite number of players, rules, objectives, and possible moves. This essentially means that games – one by one, including checkers, backgammon, and even Jeopardy! to name a few – have been taken over by AI. Most famously, in 1997 IBM's Deep Blue defeated Garry Kasparov, the then reigning world champion of chess. This trajectory persists with the ancient Chinese game of Go, and the defeat of reigning world champion Lee Sedol by DeepMind's AlphaGo in March 2016.
Definition of Artificial Intelligence (A.I.)
Artificial Intelligence

“... the science and engineering of making intelligent machines”

(John McCarthy, 1955)
Artificial Intelligence

“... technology that thinks and acts like humans”
Artificial Intelligence

“... intelligence exhibited by machines or software”
<table>
<thead>
<tr>
<th>Thinking Humanly</th>
<th>Thinking Rationally</th>
</tr>
</thead>
<tbody>
<tr>
<td>Acting Humanly</td>
<td>Acting Rationally</td>
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</table>

### 4 Approaches of AI

<table>
<thead>
<tr>
<th>#</th>
<th>Approach</th>
<th>Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Acting Humanly: The Turing Test Approach</td>
<td>(1950)</td>
</tr>
<tr>
<td>2.</td>
<td>Thinking Humanly: The Cognitive Modeling Approach</td>
<td></td>
</tr>
<tr>
<td>3.</td>
<td>Thinking Rationally: The “Laws of Thought” Approach</td>
<td></td>
</tr>
<tr>
<td>4.</td>
<td>Acting Rationally: The Rational Agent Approach</td>
<td></td>
</tr>
</tbody>
</table>

AI Acting Humanly: The Turing Test Approach (Alan Turing, 1950)

• Knowledge Representation
• Automated Reasoning
• Machine Learning (ML)
  – Deep Learning (DL)
• Computer Vision (Image, Video)
• Natural Language Processing (NLP)
• Robotics

AI and Cognitive Computing
Financial Technology

FinTech

“providing financial services by making use of software and modern technology”

Source: https://www.fintechweekly.com/fintech-definition
Financial Services
Financial Services

Source: http://www.crackitt.com/7-reasons-why-your-fintech-startup-needs-visual-marketing/
Money
Money

Money
Makes
Money
Money
Money
Wealth Management
Investment Analysis
Time Value of Money
Risk
Return
Fintech
Robo
Advisors
Big Data Driven Disruption: Robo-Advisor

Source: http://www.vamsitalkstech.com/?p=2329
FinTech high-level classification

Lending  Payments  Robo Advisors  Analytics  Others

Profile  Advice  Re-Balance  Indexing

FinTech: Financial Services Innovation

1. Payments
2. Insurance
3. Deposits & Lending
4. Capital Raising
5. Investment Management
6. Market Provisioning

Source: http://www3.weforum.org/docs/WEF_The_future__of_financial_services.pdf
FinTech: Financial Services Innovation

<table>
<thead>
<tr>
<th>功能</th>
<th>創新項目</th>
</tr>
</thead>
<tbody>
<tr>
<td>支付</td>
<td>無現金世界 (Cashless World)</td>
</tr>
<tr>
<td>Payments</td>
<td>新興支付 (Emerging Payment Rails)</td>
</tr>
<tr>
<td>保險</td>
<td>價值鏈裂解 (Insurance Disaggregation)</td>
</tr>
<tr>
<td>Insurance</td>
<td>保險串接裝置 (Connected Insurance)</td>
</tr>
<tr>
<td>存貸</td>
<td>替代管道 (Alternative Lending)</td>
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<tr>
<td>Deposit &amp; Lending</td>
<td>通路偏好移轉 (Shifting Customer Preferences)</td>
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<tr>
<td>稟資</td>
<td>群眾募資 (Crowdfunding)</td>
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<tr>
<td>Capital Raising</td>
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<tr>
<td>投資管理</td>
<td>賦權投資者 (Empowered Investors)</td>
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<tr>
<td>Investment Management</td>
<td>流程外部化 (Process Externalisation)</td>
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<tr>
<td>市場資訊供應</td>
<td>機器革命 (Smarter, Faster Machines)</td>
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<tr>
<td>Market Provisioning</td>
<td>新興平台 (New Market Platforms)</td>
</tr>
</tbody>
</table>

Source: https://www.stockfeel.com.tw/2015年世界經濟論壇－未來的金融服務/
FinTech: Investment Management
Empowered Investors
Process Externalization

Source: https://www.stockfeel.com.tw/2015年世界經濟論壇－未來的金融服務/
FinTech: Market Provisioning

Source: http://www3.weforum.org/docs/WEF_The_future_of_financial_services.pdf
FinTech: Market Provisioning
Smarter, Faster Machines
New Market Platforms

Source: https://www.stockfeel.com.tw/2015年世界經濟論壇－未來的金融服務/
Fintech: Financial Technology

Disrupting Banking: The Fintech Startups That Are Unbundling Wells Fargo, Citi and Bank of America

Source: https://www.cbinsights.com/blog/industry-market-map-landscape/
Fintech: Unbundling the Bank

Unbundling of a Bank

Source: https://www.cbinsights.com/blog/disrupting-banking-fintech-startups-2016/
Fintech: Unbundling the Bank

Wealth Management: Wealthfront

Source: https://www.cbinsights.com/blog/disrupting-banking-fintech-startups-2016/
Wealthfront: Fintech Robo Advisor

The most tax-efficient, low-cost, hassle-free way to invest

Invest with Wealthfront  See Our Journey

Do you have the time to invest well?

Wealthfront invests your money for you with a minimal amount of work. We monitor your portfolio every day to look for opportunities to rebalance or harvest tax losses. Are you doing the same?

https://www.wealthfront.com/
Financial Advisor FinTech Solutions Map

December 2018 | Latest version available at: kitces.com/fintechmap

Source: https://www.kitces.com/fintechmap
A classic workflow for financial recommendations

Process of Robo Advisors

- Knowing customer needs
- Processing Customer Information
- Customized Solution in matter of seconds

Source: https://advisesure.com/blog/what-is-meaning-of-term-robo-advisor-and--their-benefits
Benefits of Robo Advisors

- Unbiased Advice
- No minimum Investment required
- Low Charges
- Transparency
- Customised Solutions

Source: https://advisesure.com/blog/what-is-meaning-of-term-robo-advisor-and--their-benefits
Robo-Advisor Business Models

- **Full service online Robo-advisor**
  - 100% automated without any human element

- **Hybrid Robo-advisor model**
  - being pioneered by firms like Vanguard & Charles Schwab

- **Pure online advisor**
  - primarily human in nature

Source: http://www.vamsitalkstech.com/?p=2329
Robo-Advisor Business Models

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  – being pioneered by firms like Vanguard & Charles Schwab

• **Pure online advisor**
  – primarily human in nature

Source: http://www.vamstalkstech.com/?p=2329
Usecases of Robo-Advisors

1. Determine individual Client profiles & preferences
2. Identify appropriate financial products
3. Establish correct Investment Mix for the client’s profile
4. Using a algorithmic approach, choose the appropriate securities for each client account
5. Continuously monitor the portfolio & transactions within it to tune performance
6. Provide value added services
7. Ensure the best user experience by handling a whole range of financial services

Source: http://www.vamsitalkstech.com/?p=2418
Business Requirements for a Robo-Advisor (RA)

1. Collect Individual Client Data
2. Client Segmentation
3. Algorithm Based Investment Allocation
4. Portfolio Rebalancing
5. Tax Loss Harvesting
6. A Single View of a Client’s Financial History

Source: http://www.vamsitalkstech.com/?p=2354
Algorithms for a Robo-Advisor (RA)

• Leverage data science & statistical modeling to automatically allocate client wealth across different asset classes (such as domestic/foreign stocks, bonds & real estate related securities) to automatically rebalance portfolio positions based on changing market conditions or client preferences.
  – These investment decisions are also made based on detailed behavioral understanding of a client’s financial journey metrics
  – Age, Risk Appetite & other related information.

Source: http://www.vamsitalkstech.com/?p=2354
Algorithms for a Robo-Advisor (RA)

• RA platforms also provide 24×7 tracking of market movements to use that to track rebalancing decisions from not just a portfolio standpoint but also from a taxation standpoint.

Source: http://www.vamsitalkstech.com/?p=2354
Algorithms for a Robo-Advisor (RA)

- A mixture of different algorithms can be used such as Modern Portfolio Theory (MPT), Capital Asset Pricing Model (CAPM), the Black Litterman Model, the Fama-French etc.

  - These are used to allocate assets as well as to adjust positions based on market movements and conditions.

Source: http://www.vamsitalkstech.com/?p=2354
Robo-Advisor (RA) Sample Portfolios

Sample Portfolios – for an aggressive investor

1. **Equity – 85%**
   
   A) US Domestic Stock (50%)
   - Large Cap – 30%, Medium Cap – 10%, Small Cap – 10%, Dividend Stocks – 0%
   
   B) Foreign Stock – (35%)
   - Emerging Markets – 18%, Developed Markets – 17%

2. **Fixed Income – 5%**
   
   A) Developed Market Bonds – 2%
   
   B) US Bonds – 1%
   
   C) International Bonds – 1%
   
   D) Emerging Markets Bonds – 1%

3. **Other – 5%**
   
   A) Real Estate – 3%
   
   B) Currencies – 0%
   
   C) Gold and Precious Metals – 0%
   
   D) Commodities – 2%

4. **Cash – 5%**

Architecture of a Robo-Advisor (RA)

Source: http://hortonworks.com/blog/architecture-of-a-roboadvisor/
Robo-Advisor

wealthfront

Betterment
Meet your financial copilot

We'll build a free financial plan for the life you want and automate your investments at a low cost.

Our all-in-one solution gives you the financial expertise you need, right in your pocket. No spreadsheets, no annoying sales calls, no judgment.

GET STARTED

https://www.wealthfront.com/
Plan your future
Grow your wealth
Invest in your life

Access proven investment strategies, tailored advice, and premium financial services - all powered by technology.

Invest with Wealthfront  Explore your options

https://www.wealthfront.com/
Betterment
Online Financial Advisor

HELLO, INVESTOR

Betterment is an online financial advisor built for people who refuse to settle for average investing. People who demand better. People like you.

Get started
Watch our video

Right for every type of investor

New investor
I'm new to investing, or am looking for some guidance.

Hands-off investor
I invest, but don't have the time or desire to do it myself.

Hands-on investor
I'm a confident, hands-on investor looking for an optimal solution.

https://www.betterment.com/
Betterment: Fintech Robo Advisor

This is simply a smarter way to invest your money.

We help manage your financial life so you can live better.

We can help you get started. Schedule your free 15 minute call today. Schedule a call >

Increase after-tax returns.

No hidden fees.

Satisfaction guaranteed.

Access to licensed experts.

Source: https://www.betterment.com/
# Betterment vs. Wealthfront

<table>
<thead>
<tr>
<th>Feature</th>
<th>Betterment</th>
<th>Wealthfront</th>
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<tbody>
<tr>
<td>Investor Junkie Rating</td>
<td>4.5 star</td>
<td>5 star</td>
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<tr>
<td>Promotions</td>
<td>One Month Free</td>
<td>First $15k for Free</td>
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<tr>
<td>Fees</td>
<td>0.25%/yr</td>
<td>None first $10k; 0.25%/yr for more</td>
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<tr>
<td>Minimum Deposit</td>
<td>None</td>
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<tr>
<td>Human Advisors</td>
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<td>Automatic Rebalancing</td>
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<td>Tax Loss Harvesting</td>
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<td>Yes</td>
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<td>Direct Indexing</td>
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<td>Fractional Shares</td>
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<tr>
<td>Assets Under Management</td>
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<td>$5.0B</td>
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</table>

Source: https://investorjunkie.com/36355/betterment-vs-wealthfront/
Wealthfront: 0.25%
Flat annual advisory fee

• No trading commissions or hidden fees
• Portfolio of low-cost ETFs
• Your first $10,000 managed free
You're on track to have **$8,000 per month** to spend in retirement. That’s **76%** of your target.
Wealthfront Robo Advisor
Financial Revolution with Fintech

A financial services revolution
Consumer Trends

1. Simplification
2. Transparency
3. Analytics
4. Reduced Friction

Source: http://www.hedgethink.com/fintech/european-fintech-top-100/
Millennial Personal Finance: 63 Fintech Startups Targeting Millennials

FinTech Startups for Millennials

Source: https://www.cbinsights.com/blog/fin-tech-startups-millennials/
Marketing to Millennials

Marketing to Millennials

MILLENIAL PERSONAS

DIGITAL WINDOW SHOPPERS
Less engaged online than other millennials

23% of the millennial population

DIGITAL SOCIALITES
Highly social and engaged online

26% of the millennial population

DYNAMIC MEDIA JUNKIES
Extremely tech savvy and engaged with online video and streamed content

23% of the millennial population

CASUALLY ENGAGED
Least engaged in digital world, more likely to be unemployed

17% of the millennial population

EMERGING TECHNOCRACY
Strongly engaged digitally and highly influential

15% of the millennial population

Marketing to Millennials

**Best Practices for Marketing to Millennials**

**Optimized Mobile**
Mobile is the **Best Way to Reach Millennials** - they have the highest rates of ownership of smartphones of all generations.

**Multi-Platform**
Millennials **Consume Content Across Multiple Devices**, so marketers need to create content with a multi-platform strategy. For example, **55% are watching videos several times a day on multiple devices**.

**Personalization**
85% of Millennials are **More Likely to Make a Purchase if it is Personalized** to their interests, both in-store and with digital displays.

**Social Media Presence**
Millennials are **More Likely to Use Social Media Daily** with 62% reporting that brand engagement is more likely to make them a loyal customer.

**Be Authentic**
Millennials are willing to share good advertising, but **Dislike When Advertising Feels Deceptive**

**Informational Blogs**
One in three millennials choose **Blogs** as the top media source **Before Making a Purchase**. Traditional media sources like TV and magazines have less impact on this generation.

## Fintech for Millennials

<table>
<thead>
<tr>
<th>Fintech Category</th>
<th>#Company</th>
</tr>
</thead>
<tbody>
<tr>
<td>Crowdfunding</td>
<td>2</td>
</tr>
<tr>
<td>Insurance (Non-Health)</td>
<td>4</td>
</tr>
<tr>
<td>Loans &amp; Credit Risk</td>
<td>20</td>
</tr>
<tr>
<td>Mobile Banking &amp; Payments</td>
<td>8</td>
</tr>
<tr>
<td>Personal Investing</td>
<td>10</td>
</tr>
<tr>
<td>Savings &amp; Finances Tracking</td>
<td>10</td>
</tr>
<tr>
<td>Wealth Management</td>
<td>9</td>
</tr>
<tr>
<td>Total</td>
<td>63</td>
</tr>
</tbody>
</table>

Source: [https://www.cbinsights.com/blog/fin-tech-startups-millennials/](https://www.cbinsights.com/blog/fin-tech-startups-millennials/)
# Fintech: Wealth Management

<table>
<thead>
<tr>
<th>Company</th>
<th>Select Investors</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wealthfront</td>
<td>DAG Ventures, Index Ventures, Greylock Partners, The Social+Capital Partnership</td>
</tr>
<tr>
<td>Betterment</td>
<td>Bessemer Venture Partners, Athemis Group, Menlo Ventures</td>
</tr>
<tr>
<td>SigFig</td>
<td>Doll Capital Management, Union Square Ventures, Bain Capital Ventures</td>
</tr>
<tr>
<td>Aspiration</td>
<td>Renren, GSV Capital, Capricorn Investment Group, IGSB</td>
</tr>
<tr>
<td>Blooom</td>
<td>Commerce Ventures, DST Systems, Hyde Park VP, QED Investors, UMB Financial</td>
</tr>
<tr>
<td>Rebalance IRA</td>
<td>N/A</td>
</tr>
<tr>
<td>Hedgeable</td>
<td>SixThirty</td>
</tr>
<tr>
<td>WiseBanyan</td>
<td>VegasTech Fund</td>
</tr>
<tr>
<td>Personal Capital</td>
<td>Institutional Venture Partners, Venrock, Crosslink Capital</td>
</tr>
</tbody>
</table>

Source: https://www.cbinsights.com/blog/fin-tech-startups-millennials/
## Fintech: Personal Investing

<table>
<thead>
<tr>
<th>Company</th>
<th>Select Investors</th>
</tr>
</thead>
<tbody>
<tr>
<td>eToro</td>
<td>BRM Group, Ping An Ventures, Spark Capital</td>
</tr>
<tr>
<td>Openfolio</td>
<td>FinTech Collective</td>
</tr>
<tr>
<td>DriveWealth</td>
<td>Route 66 Ventures</td>
</tr>
<tr>
<td>Tip’d Off</td>
<td>Raj Parekh, Bill Crane, Shaun Coleman</td>
</tr>
<tr>
<td>Kapitall</td>
<td>Bendigo Partners, Linden Venture Fund</td>
</tr>
<tr>
<td>Stash</td>
<td>N/A</td>
</tr>
<tr>
<td>Stox</td>
<td>SingulairiTeam</td>
</tr>
<tr>
<td>Robinhood</td>
<td>Google Ventures, Index Ventures, Andreessen Horowitz, Ribbit Capital, NEA</td>
</tr>
<tr>
<td>Motif Investing</td>
<td>Norwest Venture Partners, Foundation Capital, Ignition Capital, Goldman Sachs</td>
</tr>
<tr>
<td>Loyal3</td>
<td>DNS Capital</td>
</tr>
</tbody>
</table>

Source: https://www.cbinsights.com/blog/fin-tech-startups-millennials/
Wealthfront
Investment Methodology

1. Identify an ideal set of asset classes for the current investment environment
2. Select low cost ETFs to represent each asset class
3. Determine your risk tolerance to create the appropriate portfolio for you
4. Apply Modern Portfolio Theory to allocate among the chosen asset classes for your risk tolerance
5. Monitor and periodically rebalance your portfolio

Source: https://research.wealthfront.com/whitepapers/investment-methodology/
Wealth Management Value Chain

Wealth Management Service and Potential for virtualization

AI and Robo Advisor Virtualization Dimensions

Degree of Digitalization of Wealth Management Customers

Use of Online Services by Hybrid Customers

Use of Online Services by Hybrid Customers

A: Potential for virtual interaction with client adviser (28.3% of clients)
B: Potential for largely virtual interaction with bank (43.3% of clients)
C: Potential for disruption (34.6% of clients)

Explaining Customer Experience of Digital Financial Advice

Factors

Manifest variables

Factors

Relationships measured by regression

F₆

Providers
• 1/little/a lot
• Expensive/cheap
• A/B brand

β₁ +

F₅

Service model
• A/B brand
• Expensive/cheap
• Hedonistic/utility

β₂ + +

F₄

Pre-selections
• Dialogue
• Accessible
• Transparent
• Ratings/reviews

β₃ +

F₃

Co-creation
• Dialogue
• Accessible
• Transparent
• Ratings/reviews

β₄ +

F₁

Perceived value
• Trust
• Satisfaction
• Security
• Benefit
• Ease
• Well informed

β₅ ++

F₂

Loyalty
• Repeat purchasers
• Affection

Modern Portfolio Theory and Investment Analysis

- Financial Securities
- Financial Markets
- The Characteristics of the Opportunity Set Under Risk
- Delineating Efficient Portfolios
- Techniques for Calculating the Efficient Frontier

Modern Portfolio Theory and Investment Analysis

• The Correlation Structure of Security Returns:
  – The Single-Index Model
  – Multi-Index Models and Grouping Techniques

• Simple Techniques for Determining the Efficient Frontier

• Estimating Expected Returns

• How to Select Among the Portfolios in the Opportunity Set

Modern Portfolio Theory and Investment Analysis

- International Diversification
- The Standard Capital Asset Pricing Model
- Nonstandard Forms of Capital Asset Pricing Models
- Empirical Tests of Equilibrium Models
- The Arbitrage Pricing Model APT
  - A Multifactor Approach to Explaining Asset Prices

Modern Portfolio Theory and Investment Analysis

- Efficient Markets
- The Valuation Process
- Earnings Estimation
- Behavioral Finance, Investor Decision Making, and Asset Prices
- Interest Rate Theory and the Pricing of Bonds
- The Management of Bond Portfolios

Modern Portfolio Theory and Investment Analysis

• Option Pricing Theory
• The Valuation and Uses of Financial Futures
• Mutual Funds
• Evaluation of Portfolio Performance
• Evaluation of Security Analysis
• Portfolio Management Revisited
The New Alpha: 30+ Startups Providing Alternative Data For Sophisticated Investors

New sources of data mined by startups like Foursquare, Premise, and Orbital Insight are letting investors understand trends before they happen.

Source: https://www.cbinsights.com/blog/alternative-data-startups-market-map-company-list/
The New Alpha: 30+ Startups Providing Alternative Data For Sophisticated Investors

Alternative Data Sources

Created By

Source: https://www.cbinsights.com/blog/alternative-data-startups-market-map-company-list/
FinBrain: when Finance meets AI 2.0

(Zheng et al., 2019)

Financial Intelligence

Products and services
- Wealth management
- Robo-Advisor
- Financial identity authentication
- Risk management
- Intelligent marketing
- AI customer service
- Business security
- Financial product recommendation
- Smart customer service
- Intelligent agent
- Blockchain
- ... 

Algorithms and models
- Graph algorithm
- Combinatorial optimization
- Rule engine
- Risk monitoring
- Face recognition
- Speech recognition
- Machine learning
- Deep learning
- Reinforcement learning
- Transfer learning
- Knowledge graph
- ... 

Financial big data
- Text
- Speech
- Image
- Video
- Media websites, forums ...
- Business platform (electricity supplier, payment, financial management ...)
- Government agencies (social security, civil affairs, public security, industry and commerce, taxation, court ...)
- Financial institutions (bank, insurance ...)

## Technology-driven
### Financial Industry Development

<table>
<thead>
<tr>
<th>Development stage</th>
<th>Driving technology</th>
<th>Main landscape</th>
<th>Inclusive finance</th>
<th>Relationship between technology and finance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fintech 1.0 (financial IT)</td>
<td>Computer</td>
<td>Credit card, ATM, and CRMS</td>
<td>Low</td>
<td>Technology as a tool</td>
</tr>
<tr>
<td>Fintech 2.0 (Internet finance)</td>
<td>Mobile Internet</td>
<td>Marketplace lending, third-party payment, crowdfunding, and Internet insurance</td>
<td>Medium</td>
<td>Technology-driven change</td>
</tr>
<tr>
<td>Fintech 3.0 (financial intelligence)</td>
<td>AI, Big Data, Cloud Computing, Blockchain</td>
<td>Intelligent finance</td>
<td>High</td>
<td>Deep fusion</td>
</tr>
</tbody>
</table>

AI Humanoid
Robo-Advisor
AI Humanoid Robo-Advisor
for Multi-channel Conversational Commerce

AI Portfolio Asset Allocation

AI Conversation Dialog System

Multichannel Platforms
- Web
- LINE
- Facebook
- Humanoid Robot
System Architecture of AI Humanoid Robo-Advisor
Conversational Model (LINE, FB Messenger)
Conversational Robo-Advisor
Multichannel UI/UX Robots

ALPHA 2

ZENBO
## Portfolio Performance in 2016

### Annual Portfolio Statistics

<table>
<thead>
<tr>
<th></th>
<th>Black-Litterman Portfolio - the LSTM Investor Views</th>
<th>Markowitz Portfolio</th>
<th>Equally Weighted Portfolio</th>
<th>S&amp;P 500 Index</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Annual return</strong></td>
<td>16.151%</td>
<td>15.172%</td>
<td>12.428%</td>
<td>9.643%</td>
</tr>
<tr>
<td><strong>Annual volatility</strong></td>
<td>13.897%</td>
<td>14.365%</td>
<td>15.870%</td>
<td>13.169%</td>
</tr>
<tr>
<td><strong>Sharpe ratio</strong></td>
<td>1.14697</td>
<td>1.05534</td>
<td>0.81762</td>
<td>0.76492</td>
</tr>
<tr>
<td><strong>Stability</strong></td>
<td>0.82500</td>
<td>0.82515</td>
<td>0.82514</td>
<td>0.78754</td>
</tr>
<tr>
<td><strong>Max drawdown</strong></td>
<td>-10.105%</td>
<td>-10.465%</td>
<td>-12.529%</td>
<td>-10.306%</td>
</tr>
<tr>
<td><strong>Skew</strong></td>
<td>-0.35652</td>
<td>-0.52985</td>
<td>-0.56976</td>
<td>-0.36795</td>
</tr>
<tr>
<td><strong>Kurtosis</strong></td>
<td>2.49845</td>
<td>3.00613</td>
<td>2.41894</td>
<td>2.21958</td>
</tr>
<tr>
<td><strong>Daily value at risk</strong></td>
<td>-1.688%</td>
<td>-1.750%</td>
<td>-1.948%</td>
<td>-1.619%</td>
</tr>
<tr>
<td><strong>Alpha</strong></td>
<td>0.06445</td>
<td>0.05354</td>
<td>0.02158</td>
<td>0.00000</td>
</tr>
<tr>
<td><strong>Beta</strong></td>
<td>1.01485</td>
<td>1.04816</td>
<td>1.15631</td>
<td>1.00000</td>
</tr>
<tr>
<td><strong>Information ratio</strong></td>
<td>0.10935</td>
<td>0.09129</td>
<td>0.04655</td>
<td>-</td>
</tr>
</tbody>
</table>

Portfolio Cumulative Returns

Cumulative Returns
Markowitz v.s. Black-litterment

Source: Min-Yuh Day, Jian-Ting Lin and Yuan-Chih Chen (2018), "Artificial Intelligence for Conversational Robo-Advisor", in Proceedings of the 2018 IEEE/ACM International Conference on Advances in Social Networks Analysis and Mining (ASONAM 2018), Barcelona, Spain, August 28-31, 2018
Python in Google Colab (Python101)

https://colab.research.google.com/drive/1FEG6DnGvwfUbeo4zJ1zTunjMqf2RkCrT

Portfolio Optimization and Algorithmic Trading
Efficient Frontier Portfolio Optimisation in Python

Table of contents
Python101
Python File Input / Output
OS, IO, files, and Google Drive
Python Programming
Python String and Text
Python Numpy
Python Pandas
Machine Learning with scikit-learn
  Classification and Prediction
  K-Means Clustering
Deep Learning for Financial Time Series Forecasting
Portfolio Optimization and Algorithmic Trading
  Investment Portfolio Optimisation with Python
Efficient Frontier Portfolio Optimisation in Python
  Investment Portfolio Optimization

Individual Stock Returns and Volatility

AAPL : annualised return 0.28 , annualised volatility: 0.21
AMZN : annualised return 0.34 , annualised volatility: 0.25
FB : annualised return 0.3 , annualised volatility: 0.23
GOOGL : annualised return 0.18 , annualised volatility: 0.18

Portfolio Optimization with Individual Stocks

https://tinyurl.com/aintpupypython101
The Quant Finance PyData Stack

Quantopian

PyThalesians

Zipline

DX Analytics

PyAlgoTrade

QuantLib

StatsModels

Statistics in Python

scikit-learn

Scipy

Matplotlib

Pandas

Y_i = \beta \times \mu_i + \epsilon_i

NumPy

SymPy

IPython

Jupyter

Source: http://nbviewer.jupyter.org/format/slides/github/quantopian/pyfolio/blob/master/pyfolio/examples/overview_slides.ipynb/#/5
Quantopian inspires talented people everywhere to write investment algorithms. Select authors may license their algorithms to us and get paid based on performance.

Start Coding

https://www.quantopian.com/
References