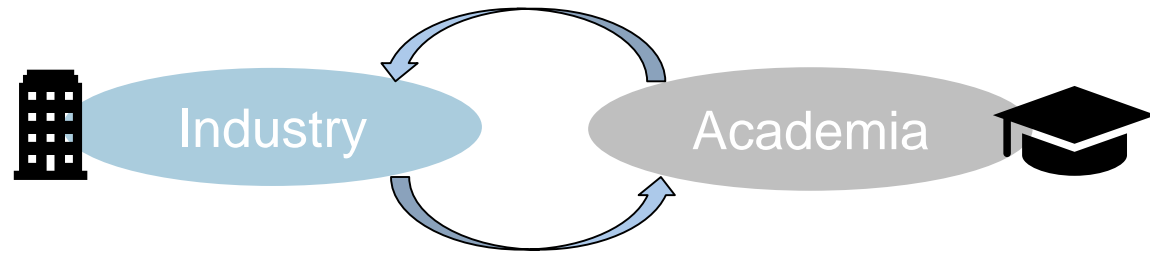


# NISS Academic Affiliate Meet-up: Collaborations Between Academia and Industry

## Multiple Pathways to Collaboration Between Academia and Industry in Data Science and Statistics



**Victor S.Y. Lo**

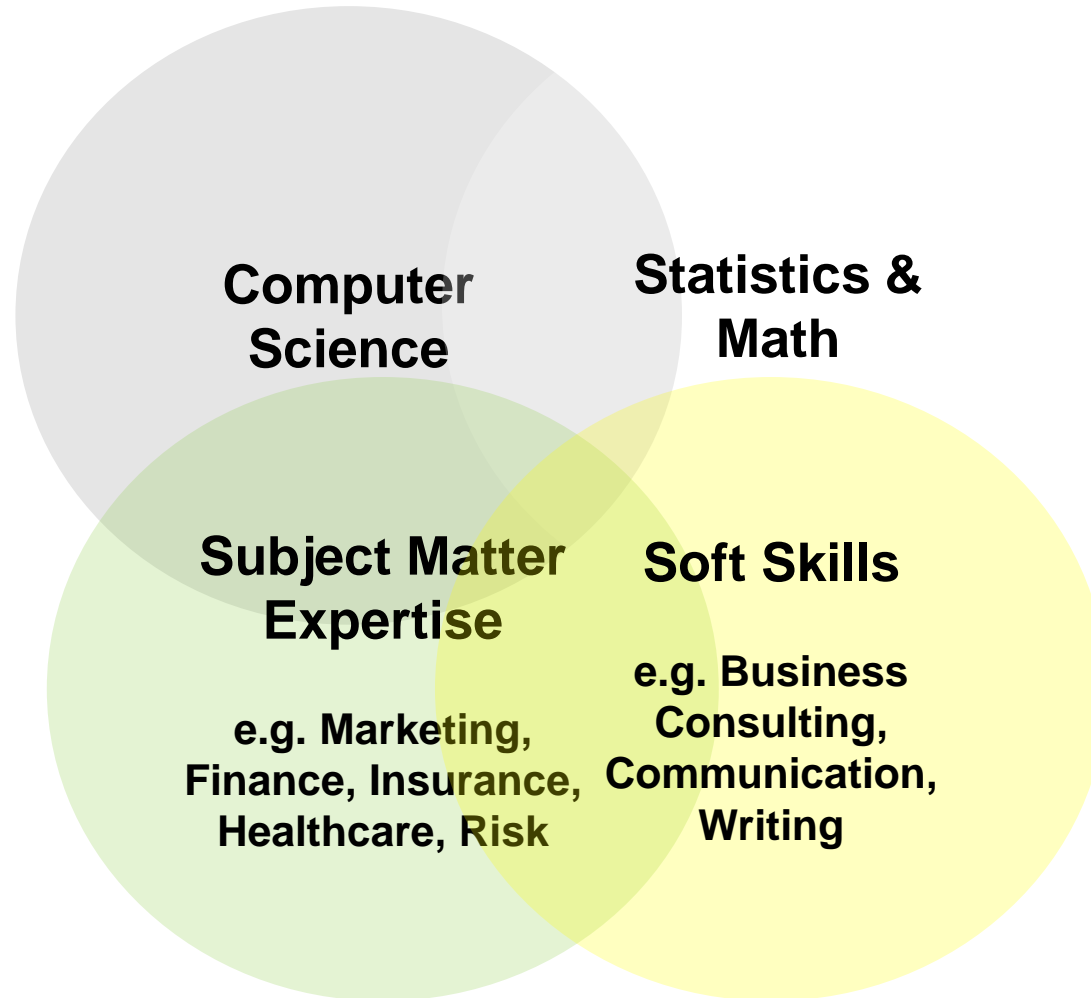
**February 2020**

## Content

- ▶ **Background: Opportunities and Knowledge in Industry**
- ▶ **Industry advising Academia**
- ▶ **Academia advising Industry**
- ▶ **Student Opportunities**
- ▶ **Research and Publications**

Disclaimer: This presentation does not represent any opinions from Fidelity Investments

# Data Science Venn Diagram



See also: Lo (2019) <https://pubsonline.informs.org/doi/10.1287/LYTX.2019.04.02/full/>

# ▶ Analytics (Data Analytics, Business Analytics)

**Prescriptive  
Analytics**

**What should we do? What is the Best Decision?**

- Support *decision making* and *proactive* actions

**Predictive  
Analytics**

**What will happen?**

- Predict *future* forward-looking behavior, events, probabilities, or trends

**Descriptive  
Analytics**

**What happened?**

- Reports and profiling
- Data visualization
- *Business Intelligence*

Source: [http://www.sas.com/news/sascom/2008q4/column\\_8levels.html](http://www.sas.com/news/sascom/2008q4/column_8levels.html), and <https://www.informs.org/Community/Analytics>

- ❑ Advice on **program and course development** and refinement:
  - How statistics or analytics is used in the industry?
  - What techniques are absolutely required? What are nice to have?
  - What programming languages are used? Software and hardware
  - Industry examples and case studies for classroom discussion
  - What other skills are needed in the industry?
- ❑ **Guest lectures or seminars** to provide industry applications for faculty and students
- ❑ **Guidance** for faculty and graduate students on industry related projects
- ❑ Collaboration on **seminar series**

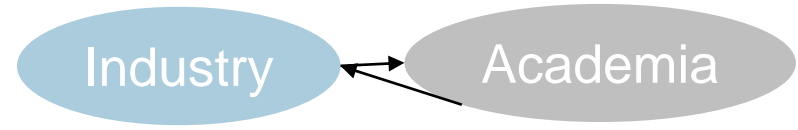
## ❑ Approaches for industry projects:

- What **methodologies and tools** are appropriate for an industry problem?
- What other approaches can be considered?
- Different academic fields can provide different kinds of guidance
- Academic **validation** of approaches

## ❑ Educational advice and support:

- What **degrees or courses** industry analysts can take to enhance and expand their knowledge? What literature should they study?
- Academia can offer **tailored courses** for:
  - Industry analysts, statisticians, scientists
  - Managers and executives
  - Top executives to promote use of analytics

# Student Opportunities



- Mentorship** for students who plan to work in industry
- Capstone projects
- Internship
- COOP
- Recruitment

- ❑ Collaboration on **papers and books** – methodologies, examples, context, analysis, industry implications
  - Academia and industry experts may have different views: depth vs breadth
  - Cutting-edge academic ideas can be applied in industry applications
  - Problems experienced in industry may lead to new academic research opportunities
  
- ❑ Where to find **DATA**?
  - Public data: e.g., Kaggle
  - Simulated data: realistic distributions and association resemble actual data
  - Actual data: generally require a lot of security procedures such as using company devices and accounts



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# APPENDIX

# Statistics Career Opportunities

Career Category	Common Titles	Industry	Common Techniques	Typical Qualification <sup>1</sup>
<b>1) Healthcare</b>	Biostatistician, Statistician, Epidemiologist	Pharma, Hospitals, Medical Insurance, etc.	Experimental Design, Statistical Analysis, Causal Inference, Machine Learning	MS, PhD in Biostat, Stat, Epid
<b>2) Data Science, AI, and Analytics</b>	Data Scientist, Business Analyst, Machine Learning Engineer, Statistician, Marketing Scientist	<u>ALL</u> Industries	Machine Learning, Statistical Modeling, NLP, Experimental Design, Causal Inference, Advanced Programming, Survey Research	MS, MBA, PhD in CS, Stat, DS, Analytics, Econ, OR
<b>3) Operations Management, Logistics, and Supply Chain Management</b>	Operations Research Analyst, Operations Analyst, Business Analyst, Data Scientist	Manufacturing, Transportation, Retail, Finance, Defense, and Others	Time Series Forecasting, Machine Learning, Statistical Quality Control, Optimization, Discrete Event Simulation, NLP, Experimental Design	BA/BS, MS, MBA, PhD in OM, OR, IE, Stat, CS
<b>4) Investment Management</b>	Quantitative Analyst, Data Scientist	Finance	Time Series Analysis, Statistical Modeling, Optimization, Financial Engineering, NLP	MS, MBA, PhD in Finance, Econ, Physics, Stat, CS, Eng, plus CFA
<b>5) Risk Management</b>	Quantitative Risk Analyst, Risk Manager	Banking, Consulting, Finance	Risk Analytics, Time Series, Statistical Modeling, Machine Learning, Cryptography	MS, PhD in Econ, Stat, Finance, Eng, plus FRM
<b>6) Actuarial Science</b>	Actuary, Actuarial Consultant	Insurance, Finance	Probability, Statistical Modeling, Time Series, Risk Analytics	BS/BA, MS in Math, AS, Stat, plus ASA/FSA

<sup>1</sup> CS = Computer Science, DS = Data Science, OR = Operations Research, OM = Operations Management, IE = Industrial Engineering, Eng = Engineering, AS = Actuarial Science, CFA = Chartered Financial Analyst, FRM = Financial Risk Manager, ASA = Associate of the Society of Actuaries, FSA = Fellow of the Society of Actuaries

# ▶ A.I. and Machine Learning Relationship

## A.I.

- 1956 Dartmouth Workshop
- Rule-Based: Teach a Machine What to Do

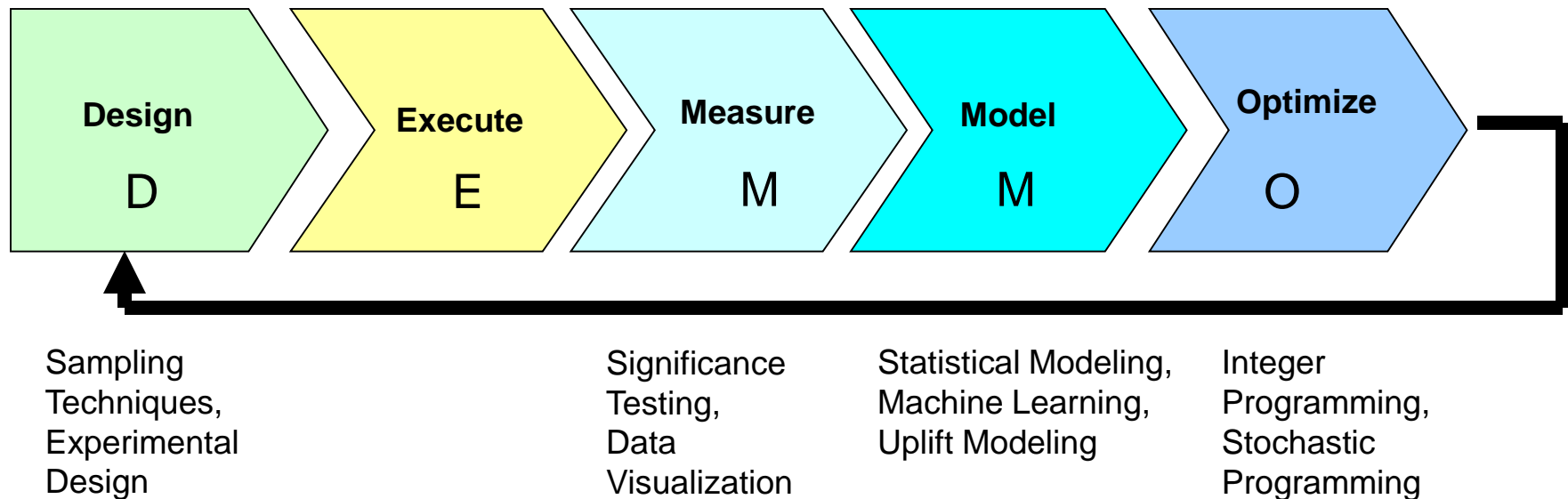
**Machine Learning:** Let the machine learn

- Feed data and set a goal
- Highly related to Statistics

**Deep Learning**

# ▶ Data Science & Analytics: Customer Relationship Management (CRM)

- ▶ Track and optimize contacts with customers
- ▶ Use historical customer contact data and apply analytics to improve future customer interactions:



# Operations Management: Call Center Analytics



- Exponential Smoothing
- Box-Jenkins
- Deep Learning

Predictive Analytics



- Queuing Theory
- Discrete Event Simulation

Prescriptive Analytics



- Linear Programming
- Stochastic Programming
- Intra-day dynamic scheduling

# 2019 Career Rankings

## **Glassdoor - Top Job: Data Scientist**

[https://www.glassdoor.com/List/Best-Jobs-in-America-LST\\_KQ0,20.htm](https://www.glassdoor.com/List/Best-Jobs-in-America-LST_KQ0,20.htm)

## **CareerCast - #1 Best Job: Data Scientist, #2: Statistician, #8: Mathematician, #9: Operations Research Analyst, #10 Actuary**

<https://www.careerCast.com/jobs-rated/2019-jobs-rated-report>

### **Summary:**

Data Scientist, Statistician, Actuary, Operations Research Analyst, Machine Learning Engineer, or Mathematician are among the best careers

## **US News - #1 Best Business Job: Statistician, #2: Mathematician, #6: Actuary, #7: Operations Research Analyst**

<https://money.usnews.com/careers/best-jobs/rankings/best-business-jobs>

## **LinkedIn - #1 Most Promising Job: Data Scientist, #15: Machine Learning Engineer**

<https://blog.linkedin.com/2019/january/10/linkedin-s-most-promising-jobs-of-2019>

# Three Levels of Talents

Type	Skills / Responsibilities	Typical Education
<b>1) Citizen Data Scientist</b>	Apply commercial software with solid interpretation; strong domain knowledge & business skills	Quantitative MBA/Master/BA/BS/BEng; or grown from Business Analyst/BI Analyst
<b>2) Practical/Business Data Scientist</b>	Ability to write advanced codes, process complex data, acquire & apply algorithms, integrate algorithms, explain findings (correlation vs causation)	MS Statistics, Computer Science, Economics, Management Science, Analytics, Data Science; PhD/ABD Economics, Marketing, Social Sciences
<b>3) Data Science Innovator</b>	Developer of new algorithms, innovation & research mindset to create new solutions and identify new problems	PhD/ABD Computer Science, Statistics, App Math, Engineering, Econometrics, Operations Research, Analytics with research & publication records



# ▶ What Do These Talents Do For Your Business?

## Type 1: Citizen Data Scientist

- Balance of Descriptive and Predictive Analytics
- Strong Domain Knowledge and other business skills

## Type 2: Business Data Scientist

- Manage clients and suppliers
- Technical skills + Domain Knowledge + Strong Communication
- Integration and Creativity

## Type 3: Data Science Innovator

- Research oriented, publications, patents
- Compete with tech firms and universities
- Develop specific powerful and world-class algorithms